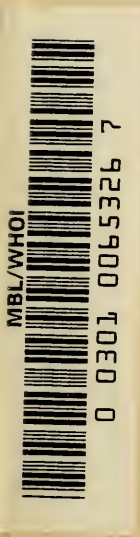
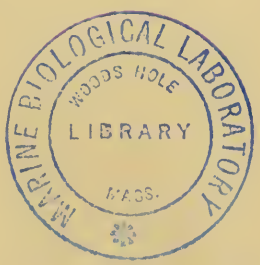
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ALLAN HANCOCK PACIFIC EXPEDITIONS
VOLUME 14 NUMBER 1

BRYOZOA OF THE PACIFIC COAST OF AMERICA

Part 1, Cheilostomata-Anasca

(Plates 1-29)

by

RAYMOND C. OSBURN, Ph.D., D.Sc.



THE UNIVERSITY OF SOUTHERN CALIFORNIA PRESS
LOS ANGELES, CALIFORNIA
1950

MARY D. ROGICK
25 PROSPECT ST., APT

CORRECTIONS

P. 54 Under **Antropora tincta**
Crassimar ginatella should be *Crassimarginatella.*

P. 90 Under **Chapperia condylata**
Plate 10, fig. 5 should be Plate 10 fig. 3.

P. 113. Under **Discoporella umbellata**
Discorporella should be *Discoporella.*

P. 145. Line 13 Kodiak Alaska was Kadiak Alaska in the original reference.

P. 194. Under Hastings 1947
Cellaraia should be *Cellaria.*

P. 204 Under description of Fig. 1, avicularian should be avicularium.

To Dr. Mary D. Rogick

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FIRST SERIES

ALLAN HANCOCK PACIFIC EXPEDITIONS

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To Mr Mary D. Rogick

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To Dr. Mary E. Rogick
with pleasant recollections of many
good days together on the
13-mycoa.
Raymond C. Osburn

REPORTS ON THE COLLECTIONS OBTAINED BY ALLAN HANCOCK PACIFIC EXPEDITIONS OF VELERO III OFF THE COAST OF MEXICO, CENTRAL AMERICA, SOUTH AMERICA, AND GALAPAGOS ISLANDS IN 1932, IN 1933, IN 1934, IN 1935, IN 1936, IN 1937, IN 1938, IN 1939, IN 1940, AND IN 1941, AND VELERO IV IN 1949.

BRYOZOA OF THE PACIFIC COAST OF AMERICA

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By RAYMOND C. OSBURN, PH.D., D. SC.

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BRYOZOA OF THE PACIFIC COAST OF AMERICA

Part 1, Cheilostomata—Anasca

By Raymond C. Osburn, Ph.D., D.Sc.

A report based chiefly on the Bryozoa collected by the Allan Hancock Expeditions, 1933-1942, in the *Velero III*.

The ten cruises of the *Velero III* and shore collections extended from the coast of Oregon to San Juan Bay, Peru, and included the oceanic islands off the coast, Socorro, Clarion, Cocos and the Galapagos. Five visits were made to the Galapagos area, otherwise the most intensive collecting was done about the islands off southern California, southward along the coast of Lower California and in the Gulf of California, a total of more than 1500 dredge-stations and 2000 additional bottom samples.

Various other institutions have contributed Pacific coast specimens toward the completion of this work, usually local material. The United States National Museum has loaned the Bryozoa from a number of the "Albatross" stations and from the Alaska Crab Investigation. The American Museum of Natural History contributed a small amount of material from the "Albatross" expedition of 1911 along the coast of Lower California. The California Academy of Science gave free access to the Bryozoa collection, made chiefly by Dr. Alice Robertson. The Hopkins Marine Station at Pacific Grove, California, presented me with a large collection, mostly from that area, made by Miss Elizabeth A. Blagg. The Pacific Biological Station at Nanaimo, British Columbia; the Oceanographic Laboratory at Friday Harbor, Washington; the Pacific Marine Station at Dillon Beach, California; the Kerckhoff Marine Station at Corona del Mar, California; the Scripps Oceanographic Institution at La Jolla, California, and the Los Angeles County Museum have all aided by the contribution of specimens. Also Dr. Paul L. Galtsoff of the U. S. Fisheries and Wildlife Service has permitted me to study the Bryozoa on a collection of pearl oyster shells (*Margaritiphora mazatlanica*) from the Gulf of Panama, about 60 species. A large gap in our knowledge of the high northern species of the Pacific coast has been well filled by the contribution of 80 species from Point Barrow, Alaska, by

Professor and Mrs. G. E. MacGinitie of the Alaska Research Laboratory. To all of these the author is grateful for the opportunity to further our knowledge of the distribution of the Bryozoa of the Eastern Pacific area.

History

The Bryozoa of the Pacific coast of the Americas have received but little attention in the past, except in a few limited areas. The first record of species is that of Alcide d'Orbigny (Voyage l'Amérique Méridionale, 1841-7), who listed 14 species from the west coast of South America as far north as the coast of Peru but, unfortunately, due to incomplete descriptions and figures, some of his species cannot be determined positively. In 1856 Busk described and listed 15 species from Mazatlan, Mexico, and in 1857 Trask recorded 5 species from the vicinity of San Francisco. Fewkes in 1889 described *Clavopora (Ascorhiza) occidentalis* from southern California. A few other scattering records appear in the works of Busk, Hincks, Waters, etc.

In the years 1882-4 the first important study of Pacific Bryozoa appeared in Hincks' report on "Polyzoa of the Queen Charlotte Islands," the material having been collected by Dr. G. W. Dawson of the Canadian Geological Survey. In this report Hincks recorded about 95 species and varieties from the waters of British Columbia, many of them new.

Dr. Alice Robertson's important work began in 1899 with a short paper on the Entoprocta of San Francisco Bay, and this was followed in 1900 by a list of 36 species taken by the Harriman Alaska Expedition, but her greatest contribution was the series of three papers (1905, 1908 and 1910) on Bryozoa of the West Coast of North America. The area covered was practically that of the west coast of the United States from Puget Sound, Washington, to San Diego, California, though some more northern forms were discussed, a total of 98 species.

Dr. Chas. H. and Elsie O'Donoghue in 1923, "A preliminary list of Bryozoa from the Vancouver Island Region," listed 170 species and 22 varieties. This was followed in 1926 by a "Second List," in which the nomenclature was revised and 20 species added.

In 1930 there appeared two papers dealing with limited tropical areas. The first of these, "The Bryozoan Fauna of the Galapagos Islands," by Canu and Bassler, recorded 56 species, many of them new, from three dredge hauls made by the U. S. Str. "Albatross." The second, by Dr. Anna B. Hastings, "Cheilostomatous Polyzoa from the vicinity of Pana-

ma Canal collected by Dr. C. Crossland on the cruise of the S. Y. St. George," listed 62 species, 27 from the Gulf of Panama, 33 from Gorgona, Colombia, and 37 from the Galapagos Islands.

It appears that the only region of the Pacific coast that has been at all adequately covered is the area from Puget Sound to southern Alaska. Robertson apparently had very little dredged material at her disposal and the number of species along the coast of the United States recorded by her is limited almost entirely to shallow water forms. Of the several thousand miles of coast from southern California southward we have had no information except for the small areas covered by the papers of Hastings and Canu and Bassler. Similarly we have had only very limited knowledge of the bryozoan fauna from southern Alaska northward.

The very extensive material dealt with in the present report should give a fair picture of the occurrence of the coastwise Bryozoa of the Eastern Pacific area from northern Alaska to Peru. No doubt many species will be added in the future and certainly our knowledge of the distribution will be greatly increased.

Distribution

As might be expected, no sharp distributional barriers have been found; instead there are several areas which are more or less distinct in their faunas but which intergrade with the regions to the north and south. Still, when one considers a sufficient number of species from any one of the following regions, the bryozoan facies is distinct enough except where the boundaries overlap. There are some species which appear to disregard temperature and range from the arctic to the tropics.

1. The arctic area of the Pacific coast extends from Point Barrow, Alaska (71° 18′ N Lat.), the most northwesterly part of the North American coast, southward to the Alaska Peninsula and the Aleutian Islands. In the Bering Sea only a few scattering collections have been made, but all of the species are high northern or arctic forms. Our knowledge of this area has been recently much extended by the work of Professor and Mrs. G. E. MacGinitie of the Arctic Research Laboratory at Point Barrow. In the summer of 1948 they collected more than 80 bryozoan species, practically all of which are known to occur elsewhere in the North Polar seas. Several of these species extend their range southward to British Columbia and even to northern California.

2. A cool water region extends from the Alaska Peninsula southward to Point Conception, California (about 35° N Lat.). The northern part of this range is rather distinct from the southern portion, but so

many species are found through the whole area that no line of separation can be drawn. The more northern species tend to disappear south of Vancouver Island and the more southern ones at the same point, but Puget Sound and southern British Columbia show a great mixture, with even a few warm water species present. In spite of the latitude, there is cool water along the California coast, with occasional inlets where the temperature is somewhat higher.

3. A more temperate area extends from Point Conception and the northern Channel Islands off southern California to Cedros Island and Point Eugenia, half way down the peninsula of Lower California (27° 30′ N Lat.). In addition to numerous species characteristic of moderate temperature there is a great mixture, with some of the more northern species reaching their limit among the Channel Islands and an increasing number of tropical species south of the Mexican boundary.

4. The truly tropical area extends from Cedros Island and the same latitude (27° 30′) in the Gulf of California to the vicinity of San Juan Bay, Peru (15° 20′ S Lat.). Throughout this wide area there is much similarity in the bryozoan fauna and the great majority of the species are limited to tropical waters. Moreover, most of the species are found widely distributed along this coast and about the outlying islands (Socorro, Clarion and the Galapagos). No doubt there are endemic species which are limited to a narrow range, but it would be hazardous to predict this in any case, as continued dredging may recover them in unexpected areas. Species hitherto known only from the Galapagos Islands have been taken by the Allan Hancock Expeditions at various places along the mainland, even as far north as the coast of Mexico and the Gulf of California.

Acknowledgments

To Captain Allan Hancock, Director of the Allan Hancock Foundation, who through financial assistance has made possible this extended research, I owe a deep debt of gratitude. To Dr. Irene McCulloch of the Foundation, who has placed many facilities for work at my disposal and whose interest in the progress of the work has been an inspiration, I am also deeply thankful. Dr. Arthur D. Howard, Mr. John D. Soule, and Miss Mary G. Marsh have relieved me of much tedious sorting of material. I must here also record the valuable assistance of my friends, Dr. R. S. Bassler of the U. S. National Museum and Dr. Anna B. Hastings of the British Museum of Natural History; Dr. Bassler has given me access to valuable type material, Dr. Hastings has made numerous comparisons for me, and both have presented me with specimens important for this study.

Glossary

Many of the following list of terms have a special application in the Bryozoa and the beginner in this group may find the definitions useful.

Ancestrula. The primary individual of a colony, derived by metamorphosis from the free-swimming larva.

Aperture. The orifice through which the tentacles are protruded, usually closed by an operculum in the Cheilostomata.

Avicularium. A modified and usually much reduced individual of a colony, without a polypide and bearing a mandible. They may be vicarious (interzooecial) or dependent (borne on some part of a zooecium).

Cardelles. Lateral denticles in the aperture for the attachment of the operculum, often wanting in the Anasca.

Communication pore. See *Septulae* and *Dietellae.*

Costules. Radiating ridges forming the frontal pericyst in the Cribrimorpha, they are modified marginal spines.

Cribrimorphs. Zooecia with a costulate front (Cribrilinidae, etc.).

Cryptocyst. A calcified inward extension from the mural rim in the Anasca, often vestigial. Between it and the ectocyst is a space, the hypostege, which serves as a hydrostatic chamber when the tentacles are extended and withdrawn.

Cell. Old name for a zooecium.

Dietellae. Small cavities around the base of the zooecial wall, in which the communication pores are located.

Distal. In Bryozoa, directed toward the oral end of the zooecium.

Dorsal. The side of the zooecium opposite that on which the aperture is located.

Ectocyst. The chitinous membrane which covers the zooecium.

Endocyst. The thin membrane lining the zooecium and enclosing the body organs.

Endozooecial. Referring to a type of ooecium (ovicell) formed by the forward extension of the distal zooecial wall. (Compare with *Hyperstomial.*)

Front, frontal. The side of the zooecium on which the aperture is located.

Gymnocyst. The calcified area of the covering membrane in Anasca. It is usually limited to the proximal end and is often vestigial or wanting.

Gonozooecium. A modified zooecium specialized for reproduction.

Heterozooecium. An avicularium or vibraculum, a highly modified and usually much reduced individual of the colony, without polypide but

with powerful muscles to operate the mandible. They are sometimes vestigial.

Hyperstomial. Referring to external ovicells. These are often more or less embedded in the gymnocyst of the succeeding zooecium but careful dissection will show that they arise above the distal wall of the zooecium to which they belong.

Hypostege. A cavity between the ectocyst (frontal membrane) and the cryptocyst in the Anasca, the hydrostatic chamber.

Kenozooecium. A member of the colony in which there is no polypide and usually no aperture, such as the stalk segments of *Caulibugula,* the internodes of radicles, etc.

Lacunae. Pores between the costae of the cribrimorphs.

Lumen. A clear line or pore on the middle of a costule in the cribrimorphs.

Lucida. A clear area in a chitinized membrane such as the operculum or mandible.

Mandible. The chitinous movable part of an avicularium; it is homologous with the operculum of a zooecium.

Mural rim. The frontal edge of the side walls, often bearing spines in the Anasca.

Onychocellarium. An avicularium in which the mandible has lateral membranous expansions (winged).

Ooecium. Any structure containing the larva during its development; it may be either hyperstomial or endozooecial.

Operculum. A chitinous membrane which closes the aperture like a trap-door in the Cheilostomata. In the Anasca it is connected proximally with the frontal membrane.

Opesia. The large orifice beneath the frontal membrane of Anasca; often occupying nearly all of the frontal area.

Opesiule. A small perforation or notch in the cryptocyst for the passage of muscles to the ectocyst in Coilostega (e.g. *Thalamoporella*).

Ovicell. The same as *Ooecium.*

Pedunculate. Elevated on a stalk or pedicel, referring usually to avicularia.

Pericyst. A calcified frontal above the ectocyst in certain Anasca, usually formed by the fusion of marginal spines.

Peristome. An elevated rim around the aperture.

Polypide. That part of the individual freely movable within the body wall and including the tentacles and intestinal tract.

Pore chamber. See *Dietellae.*

Proximal. Directed toward the point of origin of the zooecium.

Radicle. A root-like structure in certain Anasca, serving for attachment, usually consisting of a series of kenozooecia.

Sclerite. A marginal or other thickening of the operculum or mandible.

Septulae. Very small communication pores in the zooecial walls; they are either scattered singly, or aggregated in groups (uniporous or multiporous rosette plates).

Spicule. A small spine without an internal canal.

Spine. A hollow projection, more or less elongate, either open or closed at the tip, marginal or oral.

Stolon. A creeping stem, consisting of kenozooecia, from which zooecia may arise.

Tentacles. Long ciliated projections around the mouth, serving to direct the food.

Umbo. A prominence on the frontal area usually a short distance proximal to the aperture (in the Anasca usually limited to the Cribrimorpha).

Unguiculate. Shaped like a claw or talon.

Vibraculum. A highly modified avicularium, in which the long lash-like mandible can be moved in various directions.

Vicarious. Referring to avicularia occupying a place in the zooecial series (interzooecial).

BRYOZOA Ehrenberg 1831

This is a very distinct phylum of the Invertebrata, separated by a number of important characters. The name was suggested by the erect, moss-like appearance of the colonies of some of the species, but as a matter of fact, most of the species are encrusting and more like lichens than mosses in their manner of growth. The term "Polyzoa," which is still in use by English authors, was applied in 1830 by J. V. Thompson and thus antedates Ehrenberg's name for the group, but has been generally discarded on the ground that Thompson did not use this term as a class name.

Cori (1929) separated the Entoprocta from the Bryozoa to form a distinct phylum Kamptozoa. Whether this arrangement will finally be accepted or not need not concern us here, as the bryozoologists will no doubt continue to include them in their studies.

With a few exceptions among the Entoprocta, the Bryozoa are highly colonial, budding in various ways (terminal, lateral, dorsal, frontal, stolonate) to produce colonies which frequently consist of many thousands

of individuals. The individuals (usually less than a millimeter in length) are provided with a calcified or chitinous outer wall (zooecium) into which the lophophore and tentacles are retractile (in the Entoprocta the polypide is naked and the tentacles are simply rolled inward). The great majority of the species are marine, distributed from the polar regions to the tropics and from the shore line down to great depths. They are abundant as fossils from the Ordovician to Recent time.

Classes of the Bryozoa

Polypide naked, stalked; tentacles rolled inward, not withdrawn into the zooecium; anal opening within the tentacle ring. ENTOPROCTA

Polypide enclosed in a chitinous or calcified wall (zooecium); tentacles retractile; anal opening outside of the tentacle ring. ECTOPROCTA

Orders of the Ectoprocta

Mostly marine, with a circular tentacle ring. . GYMNOLAEMATA

Fresh-water Ectoprocta, with a horse-shoe shaped tentacle ring. PHYLACTOLAEMATA

Suborders of the Gymnolaemata

1. Zooecium chitinous, its opening usually circular, closed by a puckering membrane CTENOSTOMATA
2. Zooecium calcified, its opening circular, not closed by an operculum. CYCLOSTOMATA
3. Zooecial walls usually well calcified, opening by a movable opercular valve like a little trap-door. . . . CHEILOSTOMATA

Suborder CHEILOSTOMATA Busk, 1852

The cheilostomes form the dominant group among the recent Bryozoa. The zooecia are chitinized and usually calcified, often heavily so. In all but a few cases there is a chitinized operculum which operates like a trap-door to open and close the aperture through which the tentacles are extruded and withdrawn.

Hydrostatic apparatus. As the walls are rigid, compensation is necessary for the changes in internal pressure when the tentacles are protruded or withdrawn and this is accomplished by two methods: 1. there is a membranous area on the front of the zooecium which rises and falls with the changes in pressure (Anasca); 2. when the front is solidly bridged over (Ascophora), there is an internal water sac (compensation sac or compensatrix) which fills and empties through a special pore.

Communication pores. For physiological communication between adjacent individuals there are minute pores in the lateral and distal walls. These are of three kinds: 1. uniporous septulae which are arranged in a row or scattered; 2. multiporous septulae, in which case the pores are aggregated in small rounded areas known as "rosette plates;" 3. dietellae or "pore chambers," which are in the form of small cavities at the base of the vertical walls and within which the pores are located.

Polymorphism. This a common feature of this group and various names have been given to the different types of individuals: 1. autozooecia to the ordinary nutritive members of the colony; 2. gonozooecia to those specially modified for reproduction; 3. heterozooecia and kenozooecia to those modified for other functions of the colony (see glossary).

Ovicells. Ooecia or ovicells are usually present, though in some cases the eggs develop to the swimming larval stage within the zooecial cavity. Endozooecial ovicells are internal extensions of the distal wall to form small chambers, with the opening below the operculum; usually they are inconspicuous, but may be quite evident externally. Hyperstomial ovicells are developed above and distal to the aperture, usually reposing on the base of the next zooecium, and the orifice opens above the distal zooecial wall.

Avicularia and vibracula. These are highly modified and usually much reduced individuals of special function, serving as zooecial or colonial organs (see glossary).

Levinsen (1909) subdivided the Cheilostomata into the Anasca, which have a membranous frontal area and no compensatrix, and the Ascophora which have a rigid frontal area and in which the compensatrix regulates the internal water pressure.

ANASCA Levinsen, 1909

Levinsen (1909:91) defined the "Suborder Anasca" as follows: "A compensation sac is wanting, and the front wall is either wholly or in part membranaceous, or calcareous, depressed and surrounded by raised margins. In the heterozooecia the opercular and the subopercular areas are as a rule not separated by a continuous calcareous bar, but only partially by the hinge-teeth of the operculum." At the same time he set up three divisions: Malacostega, Coilostega and Pseudostega.

The Malacostega, Division I, was defined, "The individual zooecia are plainly marked off on the surface of the colony. The frontal wall quite or partially uncalcified and the operculum as a rule a membranous valve, the rim of which is chitinized, but which proximally passes over

into the frontal membrane." He included in the Division the families Aeteidae, Bicellariidae, Farciminariidae, Scrupocellariidae, Flustridae, Membraniporidae, and Cribrilinidae. It is quite evident that Levinsen included too wide a range of anascan forms within the division and Harmer later (1926) removed all but Levinsen's "Membraniporidae" and "Flustridae" to other divisions and arranged them in the following manner:

Division I. Inovicellata Jullien, 1888, Family Aeteidae.
II. Malacostega Levinsen, 1909, Membraniporidae, Flustridae and their allies.
III. Coilostega Levinsen, 1909, the Opesulidae of Jullien and related families.
IV. Pseudostega Levinsen, 1909, Cellariidae.
V. Cellularina Smitt, 1867, Scrupocellariidae, Bicellariellidae and related forms.
VI. Cribrimorpha Harmer, 1926, Cribrilinidae.

This arrangement has generally been accepted by later authors.

Still more recently Silen (1942:56), has set up another arrangement of the anascan groups, and introduced two new "sections." It is quite possible that his system may be nearer the truth, but as all of the species dealt with in this report fall within the scope of Harmer's system, that arrangement will be followed.

Division I **INOVICELLATA** Jullien, 1888

The zoarium is creeping, adnate and stolon-like. At intervals there are swollen, spindle-shaped enlargements, from each of which rises an erect zooecial tube with an operculum like a minute trap-door at the upper end. The zooecium consists of both the erect tube and the basal enlargement, as the polypide extends into both of them. There are no avicularia, vibracula, spines, nor permanent ovicells, though temporary membranous ovicells may be present until the eggs have undergone at least a part of the larval development. Polypide regeneration may occur, in which case a new "head" with a new operculum extends beyond the primary zooecial tube. One family and one genus in this Division.

Family **Aeteidae** Smitt, 1867
Genus **Aetea** Lamouroux, 1812
Genotype, **Sertularia anguina** Linnaeus, 1758:816

Key to the Species

1. Zooecial tube coarsely wrinkled or corrugate. *ligulata*
 Zooecial tube very finely or not all annulate. 2
2. Erect tube entirely without annulations. *truncata*
 Very fine annulations present 3
3. Terminal expansion spoon-shaped, base not annulated. . . *anguina*
 Terminal expansion narrower, basal expansion also finely annulated *recta*

Aetea anguina (Linnaeus), 1758

Plate 1, fig. 3

Sertularia anguina Linnaeus, 1758:816.
Aetea anguina, Robertson, 1905:244.
Aetea anguina, O'Donoghue, 1926:39.
Aetea anguina, Hastings, 1930:702.

This little creeping species is practically cosmopolitan and has been listed in nearly every paper dealing with shorewise Bryozoa in the temperate and tropical regions.

The stolonate portion adheres to stems of hydroids, algae, other bryozoans and occasionally to shells and pebbles. The erect tube is often bent or curved snake-like and the expanded terminal portion has somewhat the shape of a snake's head, so that Ellis in 1755 named it the "snake coralline." The "head," stalk and basal portion all appear to be very finely punctate and the stalk finely annulated. It must be noted, however, that there are no punctations but instead there are minute tubercles which, under transmitted light, appear to be punctures. A flat membranous area occupies one side of the "head" and at the distal end of this area is the operculum which is also thickly "punctate." The ovicell is rarely observed, and apparently it is quite evanescent. I have found it on a few occasions with the embryo surrounded by a very delicate membrane which evidently disappears after the discharge of the ciliated larva.

Robertson noted its presence at San Pedro and San Diego, California; O'Donoghue recorded it from Puget Sound, and Gabriola Pass, British Columbia, and Hastings listed it from the Galapagos Islands. On the east coast of the Americas it is a common species from Maine (Osburn 1933:18) to Brazil (Marcus 1937: 26). Cosmopolitan.

In the Hancock Expeditions it was found at numerous stations from Oregon to Peru and the Galapagos Islands, from the shore line down to about 30 fathoms.

Aetea recta Hincks, 1861

Plate 1, fig. 2

?*Hippothoa sica,* Couch, 1841:102. (Unidentifiable.)
Aetea recta, Hincks, 1880:6.
Aetea sica, Osburn, 1914:186; 1927:124.
Aetea sica, Marcus, 1937: 28.
Aetea recta, Osburn, 1940:346.

Resembling *A. anguina* in appearance, but the "head" is narrower and the whole erect portion is straighter. The operculum is set more transversely across the end of the tube and the basal portion is annulated with the fine "punctations" like the stalk.

Couch may have had this species, but as Hincks points out (1880:7, footnote), the description was drawn from an imperfect specimen, which is entirely unidentifiable and Couch placed the species in the genus *Hippothoa.*

A. recta occurs on the coast of Europe from Norway southward and on the eastern American coast it has been reported from the Tortugas Islands, Florida and the Caribbean Sea (Osburn), and from the Bay of Santos, Brazil (Marcus). It seems not to have been noted on the Pacific side of the Americas.

Hancock Stations: 325-35; 333-35; 545-36; 1012-39; 1271-41; 1281-41 and 1295-41, from the islands off southern California, the Gulf of California and Galapagos Islands, from the shore down to 80 fathoms. Also from the San Juan Islands, Puget Sound, Dr. J. L. Mohr, collector.

Aetea truncata (Landsborough), 1852

Plate 1, fig. 1

Anguinaria truncata Landsborough, 1852:288.
Aetea truncata, Robertson, 1905: 246.
Aetea truncata, O'Donoghue, 1923:16; 1926:40.
Aetea truncata, Hastings, 1930:702.
Aetea truncata, Osburn, 1947:8.

The erect tubules are straight, truncate at the tip and vary widely in height. Both the erect and basal portions are very delicately "punctate," but lack entirely the minute annulations of *anguina* and *recta.*

It is a very widely distributed species, known from the coasts of Europe, the Indian Ocean, the western Pacific from Japan to Australia, the western Atlantic from Nova Scotia to Brazil, and on the American Pacific from British Columbia to the Galapagos Islands.

Hancock Stations: dredged at 66-33, Albemarle Island, Galapagos; 391-35, Lobos de Afuera Islands, Peru; off Octavia Rocks, Colombia; 998-39, 1155-40 and 1407-41, Santa Catalina Island, and 1271-41, Anacapa Island, southern California, 10 to 36 fms. Common along shore.

Aetea ligulata Busk, 1852

Plate 1, fig. 4

Aetea ligulata, Hincks, 1884:2.
Aetea fuegensis Jullien, 1888: 1.25.
Aetea crosslandi Waters, 1910: 253.
Aetea ligulata, Marcus, 1937:30.
Aetea sica, Canu and Bassler, 1928:51.
Aetea ligulata, Osburn, 1940:347.

The erect portion of the zooecium is straight and the "head" but little wider than the stalk. The stalk is coarsely wrinkled or corrugated, quite different in appearance from the fine annulations of *anguina* and *recta* in which the appearance of annulation is produced by the arrangement of minute tubercles ("punctations"); the basal portion is also sometimes wrinkled, and both basal and erect portions are also finely "punctate."

Silen (1941:12) has described another species (*A. boninensis*) from the Bonin Islands, which has a similarly corrugated stalk, but the head is widely expanded and the basal portion smooth.

A widely distributed species recorded from Patagonia and the Straits of Magellan (Busk), Queen Charlotte Islands, British Columbia (Hincks), Terra del Fuego (Jullien), Red Sea (Waters), Bay of Santos, Brazil (Marcus), Caribbean Sea (Osburn), and Magdalena Bay, Lower California (Osburn).

In the Hancock collections it occurred commonly along shore and about the islands of southern California, and was dredged also at the following stations: 132-34 and 924-39, Socorro Island; 155-34, Albemarle Island, 170-34, Chatham Island and 179-34, Bartholomew Island, Galapagos; 411-35, Gorgona, Colombia; and 531-36, San Francisquito Bay, Lower California. Also, Gulf of Panama, Galtsoff collection on pearl oysters.

Division II MALACOSTEGA Levinsen, 1909

This Division, according to Levinsen, is "characterized by retaining the original frontal membrane in its primitive form and by having the operculum incompletely differentiated from this membrane." Harmer (1926:187) includes the families Scrupariidae, Membraniporidae, Flustridae, Onychocellidae, and Lunulariidae. Bassler (1935:22-25) removes the Onychococellidae and Lunulariidae to the Coilostega and separates out from the Membraniporidae the following families: Electrinidae d'Orbigny, Hincksinidae Canu and Bassler, Alderinidae Canu and Bassler, Hiantoporidae MacGillivray, and Arachnopusiidae Jullien.

It is quite apparent that much more study will be required before a completely satisfactory classification can be established. The great difficulty in arriving at a proper taxonomic arrangement lies in the fact that usually we cannot as yet determine the evolutionary relationships between groups of species, and this difficulty extends throughout the whole phylum.

In the Malacostega it has generally been assumed that the genus *Membranipora* is basic because of its simplicity, though recently Harmer (1926:197) and Silen (1942:55) have given the Scrupariidae a more primitive position. It is true that in the genus *Membranipora* (*sens. str.*) there is a vestigial cryptocyst and gymnocyst, no true spines, no avicularia and no ovicells, but at the same time it has as a special character, a twinned ancestrula. In the Scrupariidae the zoarium is erect and the zooecia are tubular, which may be the primitive form of the zooecium and they also lack avicularia and spines. On the other hand *Scruparia* possesses hyperstomial ovicells which appear to be a specialization. Has *Membranipora* become secondarily simplified by the loss of structural characters? Has *Scruparia* developed a hyperstomial ovicell similar to that of other cheilostomes by parallel evolution? Are the tubular zooecium and erect zoarium primitive as Silen argues; what evidence we have from paleontology appears to be against it. This is a sample of the numerous problems involved in bryozoan taxonomy and at present the best we can do is to list the families and genera in what appears to be the order of complexity as a mark of increasing specialization.

Key to the Families of the Division Malacostega

1. Zoaria erect, uniserial or biserial, no avicularia. . . Scrupariidae
 Zoaria usually encrusting; if otherwise they are multiserial. . . 2
2. Ovicells entirely absent. 3
 Ovicells present, hyperstomial or endozooecial. 4
3. Gymnocyst wanting or very slightly developed. . Membraniporidae, p. 18
 Gymnocyst well developed. Electrinidae, p. 34

4. Ovicell endozooecial. Hincksinidae p.40
 Ovicell hyperstomial. 5
5. Frontal membrane exposed, not covered by a pericyst. . . . 6
 Frontal membrane more or less covered by a pericyst, appearing like an ascophoran. 7
6. Ovicell elevated, a wide-open hood; mural rim thin and flared outward; strong distal spines. Chapperiidae p.88
 Ovicell more complete; mural rim not flared outward; spines variable. Alderinidae p.58
7. Pericyst developed from an enlarged spine and with 2 to 4 central pores. Hiantoporidae p.97
 Pericyst with numerous large pores. Arachnopusiidae p.95

Family **Scruparіidae** (Busk, 1852), Harmer, 1926

Busk established the family Scruparіidae for *Scruparia,* but included also the genera *Hippothoa, Aetea,* and *Beania* which are quite unrelated even to each other. Harmer (1926:197) limits the family to the genera *Scruparia, Eucratea* (*Gemellaria*), and *Brettia.*

"The family is characterised by the erect, frequently uniserial habit of its members, by the tendency of the zooecia to have a tubular form (perhaps a primitive feature), and by the correlated restriction of the opesia to a part of the frontal surface. Hyperstomial ovicells occur in some species, but there is no evidence that avicularia have been evolved in the family" (Harmer, 1926:197).

Key to the Genera

1. Zoarium with a creeping base and erect branches; zooecia uniserial; budding at the distal end and on the frontal immediately proximal to the opesia; ovicell hyperstomial on a dwarfed zooecium. *Scruparia*
2. Zooecia uniserial, budding usually in pairs on the dorsal side at the distal end. *Brettia*
3. Zooecia biserial, back to back; branches arise from the sides of the zooecia near the distal end. *Eucratea*

Genus **SCRUPARIA** Oken, 1815

Zoarium primarily creeping, adnate to algae and stems of hydroids and other Bryozoa, etc., but erect branches are often abundant. Zooecia tubular, nearly transparent, narrow at the proximal end where they are often slightly wrinkled, widening gradually toward the distal end. The

oval opesia occupies about half of the frontal surface. No avicularia. Ovicell hyperstomial, borne on a somewhat reduced zooecium. Genotype, *Sertularia chelata* Linnaeus, 1758.

Scruparia ambigua (d'Orbigny), 1841

Plate 1, fig. 5

Eucratea ambigua d'Orbigny, 1841 : pl. 3, figs. 13-17 ; 1847 :11.
Eucratea chelata, Robertson, 1905 :248.
Eucratea chelata, O'Donoghue, 1926 :42.
Scruparia chelata, Hastings, 1930 :702.
Scruparia ambigua, Hastings, 1941 :470.

Zoarium creeping, with erect branches; the creeping base consisting of zooecia (no stolon). The proximal end of the zooecium is tubular and gradually expanding; the opesia occupying one-third to one-half of the zooecial length and nearly parallel to the dorsal surface. Budding takes place either dorsally at the distal end or frontally immediately proximal to the opesia, the latter giving rise to erect branches.

The ovicell is hyperstomial, the fertile zooecium only slightly reduced.

This species has been much confused with *S. chelata* (Linnaeus) and Dr. Anna B. Hastings has pointed out the differences (1941). In *chelata* stolons are present, the opesia is set at a rather sharp angle to the dorsal wall, the zooecia are shorter and not so slender, and the fertile zooecia are more modified, with a much reduced opesia.

D'Orbigny described the species from the Falkland Islands (Iles Malouines), and Hastings shows that it has a very wide distribution around the world. Robertson recorded it as *Eucratea chelata* from the coast of southern California; Hastings listed it from the Galapagos Islands; O'Donoghue found it at Union Bay, Vancouver Island region, which is the northernmost record for the Pacific coast.

In the Hancock collections it is a common form about the islands off southern California and along the coast of the mainland, from low tide mark down to 150 fathoms.

Genus **BRETTIA** Dyster, 1858

The zoarium is erect and branching, the branches usually arising in pairs near the distal end on the dorsal side of a zooecium and facing in the same direction. The zooecia are uniserial, subtubular and elongate, with the opesia subterminal. In the genotype (*B. pellucida* Dyster) there are small spines, but this is not a constant character in the genus. No ovicells nor avicularia.

Brettia pellucida Dyster, 1858

Brettia pellucida, O'Donoghue, 1923:17.

Zoarium erect. The zooecia are transparent, chitinous, tubular, narrow at the base and rather evenly enlarged toward the distal end which is somewhat rounded. The opesia is parallel with the frontal surface, near the distal end, and is surrounded by 6 or 8 short spines which bend somewhat over the aperture. Daughter zooecia arise singly or in pairs from the distal end of the dorsal side.

O'Donoghue has recorded this species from Northumberland Channel and Departure Bay, British Columbia. Otherwise it is known from England. It did not appear in the Hancock collections.

Brettia tubaeformis Hincks, 1880

Brettia tubaeformis, O'Donoghue, 1923:17 and 1926:42.

The zoarium is erect, attached by radicles. Zooecia transparent, tubular, somewhat trumpet-shaped with a rounded opesia set at an angle to the axis of the zooecium. The aperture is surrounded by 8 or 10 short spinules which do not bend over the opesia.

Hincks recorded the species from the British Isles. O'Donoghue lists it from Cape Ebenshaw, Cape Lazo, and Ruxton Pass, British Columbia. Not taken in the Hancock collections.

Genus EUCRATEA Lamouroux, 1812

Gemellaria, Savigny, 1826, of most authors.

Harmer (1923:307 and 310) has straightened out the synonymy of this genus and indicates that *Gemellaria loricata* (*Sertularia loricata* Linnaeus, 1758) is the genotype.

There is a question whether this genus should be placed in the Scrupariidae, but its presence in any other known family would be even more questionable.

Eucratea loricata (Linnaeus), 1758

Plate 1, figs. 6 and 7

Sertularia loricata Linnaeus, 1758: 815.
Gemellaria loricata, Hincks, 1884:3.
Gemellaria loricata, Robertson, 1900:224.
Gemellaria loricata, O'Donoghue, 1923:17.

The zooecia occur in pairs, back to back, and branches arise from the sides of the zooecia near the distal end. The proximal end of the zooecium is tubular and gradually expanding, the opesia occupies about half the zooecial length and slopes downward to the distal rim. There are no ovicells, spines nor avicularia. The zoaria form bushy colonies sometimes nearly 100 mm in height, of a light yellowish color.

It is circumpolar in distribution and ranges down the Atlantic coasts of Europe to France and to Cape Cod in North America. On the Pacific coast it extends to southern British Columbia. Furthermore, Marcus (1937:31) has taken it at Santos, Brazil, the only positive record for the southern hemisphere, and Norman (1909:238) reported it questionably from Madeira.

Hincks and O'Donoghue listed it from a number of localities in British Columbia, Robertson from Prince William Sound and Juneau, Alaska, and Osburn (1923) from Point Barrow, Alaska.

In the Hancock collections there are specimens from Kodiak, the Pribilof Islands and Point Barrow, Alaska.

Family **Membraniporidae** Busk, 1854

There has been much dispute in regard to this family and it is difficult to draw a diagnosis. In general the simplicity of its members is the most striking character. The opesia is nearly as large as the zooecial front and the frontal membrane covers the whole surface; the gymnocyst is wanting or much reduced except in *Desmacystis;* the cryptocyst varies from scarcely discernible to filling half of the opesia; ovicells are entirely wanting; avicularia are wanting in most of the species, but incipient vicarious avicularia, little modified and as large as the zooecia, are found in a few species; in *Desmacystis* there is a median frontal avicularium, and in *Cupuladria* there are highly specialized vibracula. Mural spines are wanting, but tubular processes or low tubercles may be present at the distal corners.

Key to the Genera of Membraniporidae

1. Zoarium free, cupuliform, long vibracula present. . . *Cupuladria*
 Zoarium attached, encrusting or erect. 2
2. Gymnocyst covering proximal half of zooecium, a median avicularium proximal to the opesia. *Desmacystis*
 Gymnocyst wanting or little developed. 3
3. Triangular open areas, or triangular or rounded knobs on the basal corners, developed on a small gymnocyst. . . *Conopeum*

Knobs or tubular spines, if present, developed usually by the folding of the distal rim, gymnocyst usually wanting. *Membranipora*

Genus MEMBRANIPORA Blainville, 1830

Biflustra d'Orbigny, 1852.
Nitscheina Canu, 1900 (*Nichtina* by error, according to Canu).
Acanthodesia Canu and Bassler, 1920.

Blainville erected the genus *Membranipora* to include 6 species all of which, except *membranacea* Linnaeus, have been placed elsewhere, leaving *membranacea* as the genotype.

Canu, under the impression that *Membranipora* was not properly founded, replaced it by *Nitscheina* (*Nichtina* by a printer's error) with *M. membranacea* as the genotype.

Biflustra d'Orbigny was not figured; the description is unrecognizable, was apparently meant to include bilaminar forms, and has been discarded.

Canu and Bassler separated *Acanthodesia* from *Membranipora* or *Nitscheina* (*Nichtina*) by the following diagnosis: "No ovicell. The opesium is garnished laterally by small spinous processes and inferiorly by a serrate denticle. Fifteen tentacles." The description was based on *Flustra savartii* Audouin as the genotype and no other species included. Since 1920 Canu and Bassler, Harmer, Hastings, Marcus and Osburn have added numerous species with the lateral cryptocystal spinules.

Borg (1931:1-30) has thoroughly investigated the status of *Flustra membranacea* Linnaeus and the species with which it was confused by older authors and concludes that *Membranipora* is a good genus with *membranacea,* as now understood, as the genotype, an opinion with which the present writer is in accord.

With *Biflustra* and *Nitscheina* discarded, the only question that remains is that of the status of *Acanthodesia* and, frankly, I am unable to draw any definite line between *Membranipora* and *Acanthodesia,* though if there were not a continuous series of intergradations between *membranacea* and *savarti* the distinction would be clear enough.

1. Both species have twinned ancestrulae.
2. Mural spines are wanting in both.
3. The gymnocyst is wanting or vestigial.
4. The cryptocyst is well developed in *savarti* and barely visible in *membranacea,* but other species show all the intermediate conditions and the proximal dentate tooth of *savarti* is frequently wanting on both

the erect and the encrusting stages. The spinules margining the inner edge of the cryptocyst are variable in the extreme; rarely seen in *membranacea*; in other species there may be a few small ones, a few larger ones, or they may be numerous along the sides to the level of the operculum; sometimes they fringe the edge of a broad cryptocystal shelf.

5. The generic description of *Acanthodesia* indicates only two differential characters, the proximal dentate tooth and the lateral cryptocystal spinules, both of which are frequently wanting on the erect stage and especially on the encrusting stage of the genotype *A. savarti.* Furthermore the erect character of *savarti* cannot be considered of much importance since the zoarium is often broadly encrusting and some other species which have been placed under *Acanthodesia* may rarely develop bilaminate folds or frills.

As a result of the above analysis I feel obliged to return the species of *Acanthodesia* to *Membranipora.* It is a question of retaining *Membranipora* for the whole series or of placing them all under *Acanthodesia,* unless some more positive differential character can be determined. As *Membranipora* appears to be properly established, *Acanthodesia* must go into synonymy.

Key to Species of *Membranipora*

1. Cryptocyst narrow or wanting. 2
 Cryptocyst better developed, usually extending forward around the aperture. 5
2. Cryptocyst wanting, rarely a trace; tubular distal short spinous processes. *membranacea*
 Cryptocyst present forming a narrow shelf. 3
3. Cryptocyst smooth; no tubercles; thick brownish ectocyst . *pachytheca*
 Edges of cryptocyst serrate. 4
4. Frontal membrane with chitinous spinules; distal spines long, acute, the bases often calcified. *villosa*
 Only the distal spines present, short and tubular . . *serrilamella*
5. Distal tubercles heavily calcified, often fused across the middle, sometimes spine-like. *tuberculata*
 Tubercles, if present, low rounded knobs. 6
6. A flat shelf extends inward from the edge of the descending cryptocyst. 7
 The descending cryptocyst only, with a few spinules. 8
7. Cryptocyst very broad and evenly developed on the sides, with long, evenly distributed spinules. *hastingsae*
 Cryptocyst broad proximally, very irregular, with spinules of various sizes and forms. *tenuis*

8. Zoarium encrusting only, a pair of low distal tubercles, operculum with dark brown border. *fusca*
 Zoarium erect from encrusting base; no tubercles. 9
9. Erect part of zoarium forming complex bilaminate frills, zooecial walls thin, proximal cryptocyst narrow. . . . *perfragilis*
 Narrow, ligulate or forked, bilaminate erect branches, or encrusting; proximal shelf broader, walls heavier. . . . *savarti*

Membranipora membranacea (Linnaeus), 1767

Plate 1, figs. 8 and 9

Flustra membranacea Linnaeus, 1767:1301.
Membranipora membranacea, Hincks, 1884:11.
Membranipora membranacea, Robertson, 1908:267.
Membranipora membranacea, O'Donoghue, 1923:26.

The zoarium encrusts almost any object that will afford attachment, though the surfaces of the broader algae are the usual habitat and here the colonies may cover several square inches. The zooecia are very simple in structure, especially in younger and rapidly proliferating colonies. Characteristically they are elongate-quadrate and straight, with very thin walls and the opesia occupy the whole frontal surface. The gymnocyst and cryptocyst are wanting (vestigial) and there are no avicularia and no ovicells. At each distal corner there is usually a knob or process which appears to be formed by a fold of the terminal wall as the distal side is membranous in younger stages. Occasionally these knobs may be produced into hollow tubes or pointed short spinous processes. Not infrequently there appears on the frontal membrane, a tall membranous tube, as much as 0.50 mm high, closed at the end, the "tower cells," or "Thurmzooecien" of Nietsche. What may be the function, if any, of these structures, unique among the Bryozoa, is still a question, though they may be homologous with the large chitinous spines of *M. villosa.* (Pl. 1, fig. 11).

It has been reported from various regions around the world, though with what certainty it is difficult to determine. Definitely it occurs on the coasts of Europe, along the Atlantic coast of North America south to the Caribbean Sea, and on the Pacific coast. It is fairly common along the shores of southern California. Hincks listed it from the Queen Charlotte Islands and O'Donoghue from Ucluelet, British Columbia, and Robertson recorded it from Alaska, Puget Sound, and California.

Hancock Stations: 1370-41 and 1406-41, Catalina Island, California, and 287-34, Cedros Island, Lower California. Abundant on the larger frondose algae along the California coast.

Membranipora villosa Hincks, 1880

Plate 1, figs. 10 and 11

Membranipora villosa Hincks, 1880a:84.
Membranipora villosa, Robertson, 1908:268.
Membranipora villosa, O'Donoghue, 1923:26; 1926:29; 1926:250.

The zoarium is encrusting, especially on the larger kelps, the colonies often coalescing to cover considerable areas. The zooecia are of moderate size, thin-walled; the gymnocyst is wanting or limited to the proximal corners; the cryptocyst narrow proximally and laterally, finely crenulate and often with a few minute spinules; the opesia occupying practically all of the front. A characteristic feature is the chitinous spinules; minute spinules arise on the frontal membrane almost anywhere except on the operculum; slightly larger ones, often nearly as long as the width of the zooecium, arise just within the lateral margins; a still larger and heavier spine is located at each proximal corner, and one still larger, 0.50 mm or more is frequently found in a median position. All of these spines are elongate-acuminate, the basal ones sometimes forked, and without calcification except the bases of the larger ones in the proximal corners.

The development of this species has been well discussed by Robertson (1908:269-275) and O'Donoghue (1926a:249-261). There is a twin ancestrula, the earlier zooecia are somewhat hexagonal in form, but the later zooecia are elongate-quadrilateral much like those of *M. membranacea* and the spinules are less marked, often nearly wanting on the later zooecia.

Hincks described the species from California; Robertson listed it from Puget Sound to San Diego, California, and O'Donoghue from numerous British Columbia localities.

It did not occur in the Hancock dredgings but it is abundant on the kelps all along the California coast.

Membranipora serrilamella new name

Plate 1, figs. 12 and 13

Membranipora membranacea form *serrata* Hincks, 1882:469.
Membranipora serrata, Robertson, 1908:268.
Membranipora serrata, O'Donoghue, 1923:26; 1926:29.
Conopeum serrata, Okada, 1929:11.
Membranipora serrata, Okada, 1934:4.
Acanthodesia serrata, Marcus, 1937:44.
(Not *Membranipora serrata* MacGillivray, 1868:6).

Zoaria encrusting, especially on the broader algae where the colonies often coalesce to cover nearly the whole frond. The zooecia are of moderate size, about 0.50 mm long by 0.20 to 0.25 mm wide, usually not so regularly elongate-quadrate as in *M. membranacea* but otherwise resembling that species. The walls are thicker and there is a narrow cryptocyst on the proximal and lateral sides which is irregularly serrated with short laterally directed spinules; there is often a somewhat longer spinule at the proximal end. There is consistently a short hollow spine or protuberance at each distal corner, developed by the folding of the distal rim; in older stages of calcification these spines may become closed at the tips. The ancestrula is twinned like that of *M. membranacea.*

Hincks' specimens were from Virago Sound, British Columbia; Robertson records it from Puget Sound to southern California; O'Donoghue lists it from numerous localities in British Columbia; Marcus found it at several localities in Brazil, and Okada records it at a number of places in Japan. The form which Hastings listed as *Acanthodesia serrata* from Balboa, Canal Zone, belongs elsewhere (see under *Membranipora hastingsae* n. sp.).

The name *serrata* as applied to this species is preoccupied by *Membranipora serrata* MacGillivray, 1868:6, and a new name is necessary.

Excessively abundant on the floating fronds of kelp and dredged on a few occasions down to 10 fathoms.

Membranipora tuberculata (Bosc), 1802

Plate 2, figs. 4, 5 and 6

Flustra tuberculata Bosc, 1802:143.
Flustra tehuelcha d'Orbigny, 1839-46:17.
Membranipora tehuelcha, Robertson, 1908:265.
Nichtina tuberculata, Harmer, 1926:208.
Nichtina tuberculata, Hastings, 1930:706.
Membranipora tuberculata, Osburn, 1947:9.

This is the well-known "Gulfweed" bryozoan which Bosc described as occurring "en immense quantité sur les fucus nageans sur l'Atlantique."

The zoarium forms a white lace-work on Sargassum floating over the wide oceans and occurs on attached algae along shore in warmer waters. The zooecia are quadrangular, but shorter and wider than in *M. membranacea* and the walls are much more heavily calcified. Characteristically there is a pair of tubercles at the distal corners, which appear to be formed as folds of the distal rim as they are open and covered by

membrane on the distal side. They are very variable, frequently fusing across the end of the zooecium and occasionally they are cornuate, extending forward with the points curved toward each other, and more rarely a third tubercle is developed between these in the midline. A short gymnocyst is sometimes present and the cryptocyst, with lateral spinules is usually well developed at the proximal end.

Found wherever Sargassum drifts over the warmer seas; along shore on the Atlantic coast from North Carolina to Brazil; on the Pacific coast from California to Peru and the Galapagos Islands; southern Japan, Indian Ocean and the East Indies.

Dredged in shallow water, usually on algae, by the Hancock Expeditions at numerous stations from California to Peru.

Membranipora perfragilis (MacGillivray), 1881

Plate 2, fig. 8

Biflustra fragilis MacGillivray, 1869:138.
Biflustra perfragilis MacGillivray, 1881:27 (changed the name).
Membranipora perfragilis MacGillivray, 1895:39.
Membranipora crassimarginata var. *erecta* Busk, 1884:63.
Membranipora perfragilis, Hincks, 1884:278.
Amphiblestrum perfragile, Ortmann, 1890:29.
Membranipora serrata, Robertson, 1908:269 (in part).
Acanthodesia perfragilis, Hastings, 1945:98.

The zoarium encrusting and rising free into richly convoluted or frilled and variously contorted masses, the frills often anastomosing; bilaminar, the layers back to back, but occasionally one layer may extend slightly beyond the other. In the free frills the zooecia are regularly disposed, quite regular in form, the lateral walls parallel, the distal wall arcuate; 0.50 to 0.60 mm long by 0.25 to 0.30 mm wide. The zooecia of the encrusting base vary greatly in size and proportions, sometimes being as wide as they are long. The mural rim is finely crenate, the distal as well as the lateral walls. The cryptocyst is distinct, narrow on the sides but continued around the distal end of the opesia; usually broader at the proximal end, but sometimes limited to the proximal corners.

There are incipient interzooecial avicularia, smaller than the zooecia, with a spatulate mandible which is without pivot. They appear to be rare and I have found them only on the encrusting base.

It is recorded as common in Australian waters and is known also from Japan. Robertson (1908:269), under *M. serrata,* reports of that

species, "at Monterey, California, it occurs free, very much folded and contorted foliaceous masses," and it seems probable that these specimens were *perfragilis*.

A remarkable colony, shaped like a large pompon, was collected in shallow water at San Pedro, California. The zoarium measures about 140 mm in length by 100 mm in width and height, and is remarkably convoluted. It is attached to a large pebble, the encrusting base being more than half as wide as the erect portion and spreading down over the sides of the pebble. The specimen is deposited in the Cabrillo Beach Marine Museum of the City of Los Angeles and the author is indebted to Dr. W. L. Lloyd, Director of the Museum, for the privilege of studying the specimen. Some fragments of the zoarium are deposited in the Hancock collections.

Membranipora fusca new species

Plate 1, fig. 14

Zoarium encrusting on shells and stones, covering considerable areas; at first the thick ectocyst is clear, then the operculum develops a heavy dark border and later the whole ectocyst becomes yellowish brown, then darker to nearly black.

The zooecia are moderate in size, usually ranging between 0.50 and 0.70 mm in length and 0.30 to 0.45 mm in width, the opesia occupying nearly all of the front; a narrow brown line separates the zooecia even in younger stages. The descending cryptocyst is broadest at the proximal end and continues more narrowly along the sides, finely granulated and without spinules. The basal gymnocyst is only wide enough to bear a pair of transversely elongate low tubercles, which in final calcification may fuse in the midline or become heavy rounded knobs. The operculum is semicircular, about 0.20 mm in width, heavily chitinized like the frontal ectocyst and with a conspicuous black border. Multiporous septulae are present in both the lateral and distal walls. No spines nor avicularia and no ovicells.

Type, AHF, no. 9.

Type locality, Mussel Point, northern California, 36°37′20″ N, 121° 54′15″W. Also at Del Monte, California, 36°37′00″N, 121°53′00″W, intertidal to 6 fms, collected by Miss A. E. Blagg and Dr. R. L. Bolin, numerous colonies; also at Tomales Bay, California, 5 fms (Osburn).

Membranipora tenuis Desor, 1848

Plate 2, figs. 9 and 10

Membranipora tenuis Desor, 1848:66.
Membranipora denticulata Busk, 1856:176.
Biflustra denticulata, Smitt, 1873:18.
Hemiseptella denticulata, Canu and Bassler, 1928:62.
Acanthodesia denticulata, Hastings, 1930:707.

The *M. denticulata* of Busk from the Pacific coast and the *Biflustra denticulata* of Smitt from the Atlantic are definitely the same species and the same as the *tenuis* of Desor, according to Dr. Anna B. Hastings (*in litt.*) who has examined Busk's type material and a large number of other specimens in the British Museum from various Atlantic and Pacific localities.

Zoarium encrusting anything that affords attachment, but most common on shells and stones; occasionally rising in free, bilaminate frills similar to those of *M. perfragilis* but more delicate. The zooecia are moderate in size, 0.45 to 0.50 mm long by 0.20 to 0.25 mm wide, but often with a much wider range. The walls are moderately high and the mural rim roughly and irregularly granulated; usually there is no evidence of a gymnocyst; the cryptocyst is well developed and exceedingly variable, proximally it forms a broad shelf which extends more narrowly along the sides and then becomes somewhat broader around the distal border. Occasionally the shelf may fill in the whole basal half of the opesia, or it may be limited to a narrow band; the border of the shelf bears very irregular and sometimes branched spinules, which may extend laterally half way across the opesia or the border may be merely irregularly serrate. The proximal shelf is flat and smooth except for a few to many minute tubercles. The ectocyst is slightly brownish and often there is a distinct brown line separating the mural rims. The operculum is slightly more heavily chitinized than the frontal membrane and has a thick brown border; width 0.13 mm.

No ovicells, no avicularia, no spines, no dietellae. Small rough processes may occur at the proximal corners, but these are extremely variable in size and occurrence. The variations in zooecial size and form, the extent of the cryptocyst, and the presence or absence of the tubercles have led to the description of several supposed new species; *Membranipora danica* Levinsen, from Denmark, and *Hemiseptella africana, H. hexagonalis* and *H. grandicella* of Canu and Bassler appear certainly to belong under *tenuis*.

It is an abundant species along the Atlantic coast from Cape Cod to Brazil, in shallow water along the shores and entering estuaries where the salinity may be reduced to less than one-half that of sea water. It does not appear to be as abundant anywhere on the Pacific coast. Busk's material of *denticulata* came from Mazatlan, Mexico, and Hastings recorded it from several localities in the Canal Zone and from the Galapagos Islands. Probably because it is a shallow water species it did not appear frequently in the Hancock dredgings, as it was not taken below 16 fathoms.

Fairly common along the coast of southern California and down the west coast of Lower California; at Stations 1044-40 (Tiburon Island), 1049-40 (Angel de la Guardia Island) and 1071-40 (San Felipe Bay) in the Gulf of California; Station 374-35 at Independencia Bay, Peru. Also at Acapulco Bay, Mexico, specimens collected by Captain F. E. Lewis.

Membranipora savarti (Audouin), 1826

Plate 2, fig. 7

Flustra Savartii Audouin, 1826:240.
Biflustra Savartii, Smitt, 1873:20.
Acanthodesia savartii, Canu and Bassler, 1920:100; 1930:4.
Acanthodesia savartii, Marcus, 1937:40.
Acanthodesia savarti, Osburn, 1947:9.

The zoarium is erect, with narrow ligulate or bifurcate bilaminate fronds rising from an encrusting base which may spread over an area of a square centimeter or more. The zooecia of the erect fronds are regularly elongate-quadrangular, moderate in size, the walls rather heavily calcified and granulated. The cryptocyst forms a horizontal shelf at the proximal end with a denticulate process projecting into the opesia, and there are also denticles projecting from the narrower lateral cryptocyst.

The proximal horizontal dentate process of the cryptocyst is a very striking character when it is present, and the genus *Acanthodesia* was founded on it. However it is very often wanting entirely, or present on only a few zooecia of a colony. I have failed to find any evidence of it in Pacific coast specimens which otherwise agree perfectly. On the other hand, Silen (1941:19) found "the proximal denticle prominent in all specimens" from the Bonin Islands, Japan.

It is a common species around the world in warmer shallow waters.

Dredged at 14 Hancock stations: off Point Loma, California; Tiburon Island, Gulf of California; Lower California at Dewey Channel

and Fraile Bay; Port Culebra, Costa Rica; Secas Islands and Bahia Honda, Panama; James, Hood, Indefatigable and Chatham Islands, Galapagos, the greatest depth being 40 fms.

Membranipora pachytheca new species

Plate 2, figs. 2 and 3

Zoarium encrusting shells, white in the young, brownish in color when fully developed. The zooecia are large (average about 0.85 mm long, but ranging from 0.65 to 1.10 mm, and in width ranging from 0.45 to 0.65 mm); ellipsoid with the distal end evenly rounded and slightly elevated; distinct; the walls very thin; opesia occupying all of the front; no evident gymnocyst; a slight horizontal cryptocyst, usually in the proximal corners but often there is no evidence of it. The mural rim is smooth and exceedingly thin, there is no evidence of a descending cryptocyst and the horizontal cryptocyst is minute and perfectly smooth. The frontal ectocyst is thick, pale brownish, and covers the whole of the frontal surface, forming a thin brown line above the adjoining mural rims and continued more heavily around the distal end of the zooecium. The operculum is heavily chitinized and brownish in color, slightly arcuate in cross-section, very large (0.25 to 0.30 mm in width by 0.25 to 0.30 mm in length) thinner at the edges, with a sclerite on either side a little way within the margin. In the side walls there are 4 multiporous rosette plates, while in the distal wall there are numerous single pores which form a band across it at its middle. The tentacles are numerous, about 20. There are no avicularia and no ooecia; developing ova can be observed in the body cavity.

This is an unusual appearing species, looking at first sight like an encrusting *Alcyonidium;* on being calcined the thin walls and large opesia suggest *Aplousina* but there is no evidence of endozooecial ovicells. The negative characters, such as the absence of the gymnocyst, the vestigial cryptocyst, the absence of spines, denticles, avicularia and ooecia, the reduced calcification and the nature of the communication pores all appear to indicate *Membranipora* as the proper genus.

The most striking characters are the large, arched, leathery operculum, the rounded distal ends of the large zooecia and the unusually thin walls.

Type, AHF no. 10.

Type locality, Canoe Bay, Alaska, 40 fathoms, on shells, several colonies, one more than an inch across (Alaska Crab Investigation).

Membranipora hastingsae new species = preocc. + = renamed M. annae of Osburn 1953: 774

Plate 2, fig. 1

Acanthodesia serrata, Hastings, 1930:707.

Zoarium encrusting. The zooecia are moderate in size, elongate and quite regularly quandrangular in form; walls very thin. The most characteristic feature is the very extensive development of the cryptocyst, which extends broadly on the sides to the level of the operculum, with numerous elongate spinules, rather evenly spaced, which nearly meet across the opesia and which occur on the entire lateral cryptocyst as far as to the operculum. The polypide chamber is thus almost enclosed beneath the cryptocyst and its horizontal spinules. At each corner there is a triangular area which appears to occupy all of the gymnocyst and which develops into a nodule, according to Hastings, or a short spine.

Dr. Hastings has described incipient avicularia of the same size as the zooecia and possessing a polypide, but with a greatly enlarged and somewhat modified operculum. The small specimen in my possession does not show the avicularia, but otherwise the agreement with her description and excellent figures (Plate 4, figs. 13-15) is perfect.

Dr. Hastings was evidently in error in listing this form under the *serrata* of Hincks for the following reasons: (1) the cryptocyst is remarkably broad and evenly developed on the sides and extends to the distal wall, where it leaves only space for the operculum (in *serrata* the cryptocyst is always narrow); (2) the spinules are long, extending nearly or quite to the median line, very equally developed and evenly spaced to the opercular area (in *serrata* the edge of the cryptocyst is crenate, with occasional shorter denticles irregularly distributed); (3) the spines at the corners are much less developed than in *serrata.* Furthermore I have examined large numbers of *serrata* and found no evidence of "incipient avicularia."

It is a pleasure to name this species for Dr. Anna B. Hastings of the British Museum of Natural History, who has done so much to further our knowledge of the Bryozoa.

The type material consists of a single colony from Balboa, Canal Zone, sent to me for identification by the William F. Clapp Laboratories of Duxbury, Massachusetts. Dr. Hastings recorded it as *Acanthodesia serrata,* also from Balboa "docks, buoy and shore."

Type, AHF no. 11.

Type locality, Balboa, Canal Zone. Also from Perlas Islands, Gulf of Panama, F. H. Bradley, collector.

Genus CONOPEUM Gray, 1848

This genus is especially characterized by the development of triangular cavities on the surface of the gymnocyst at its proximal corners ("interopezial cavities"). In the early growth of the zooecium the small gymnocyst is smooth, then calcified walls begin to enclose a triangular space, sometimes in each basal corner, sometimes in only one corner, and very frequently they may be wanting over a large portion of a colony. As calcification becomes complete, triangular or rounded knobs, with a small membranous aperture, are formed. These may even become closed and also they may be fused across the basal part of the zooecium to form irregular quadrangular lumps or knobs. Avicularia and mural spines are wanting. (See Marcus 1937:36, and Osburn 1940:350). Genotype, *Flustra lacroixii* Audouin, 1826.

Conopeum commensale Kirkpatrick and Metzelaar, 1922

Plate 2, figs. 12, 13, 14 and 15

Kirkpatrick and Metzelaar, 1922:985.
Marcus, 1937:35, 1938:16, 1939:126 (discussion).

The zoarium usually encrusts shells, especially gastropod shells inhabited by hermit crabs; white in earlier stages, becoming yellowish and finally brown; multilaminar.

The zooecia are rather regular in arrangement, roughly quadrangular or elongate-hexagonal, the outlines marked by a very distinct dark brown line. The membranous ectocyst covering the frontal surface is thickly studded with chitinous, villose spinules, especially around the border; these spinules are semierect, pointed toward the center of the zooecial area, and do not occur on the mural rim. The zooecial walls are heavily calcified and the mural rim as well as the descending cryptocyst is granulated. The opesia is ovoid in form and the operculum well chitinized, with a somewhat heavier border, yellowish in color.

Originally found at a number of localities in northwest Africa. Marcus (1937:36) records it from various places in Bahia de Santos, Brazil, and gives an excellent account of it.

There is much variation in the form of the tubercles and they may be single or double, large or small, and may often be wanting over considerable areas of a colony. The chitinous ectocystal spinules also show much variation, usually numerous in our material, but sometimes wanting altogether. Kirkpatrick and Metzelaar did not mention them in

their description, but a specimen from Cape Blanco, West Africa, the type locality, received through the kindness of Dr. Anna B. Hastings of the British Museum, shows a very few delicate, almost transparent spinules.

The Hancock Expeditions recovered this species from off Guaymas (Station 1092-40) and Tepoca Bay (Station 1078-40), Sonora, Mexico; Santa Maria Bay, Lower California (Station 1031); Cocos Bay, Costa Rica (Station 116-33), and La Plata Islands, Ecuador (Station 212-34). Dr. Howard R. Hill of the Los Angeles Museum has presented the writer with a specimen from San Felipe, western Mexico. It is therefore widely distributed in warm waters along the Pacific coast from northern Mexico to Ecuador. Depth 2 to 45 fathoms.

Conopeum reticulum (Linnaeus), 1767

Plate 2, fig. 11

Millepora reticulum Linnaeus, 1767:1284.
Membranipora lacroixii, Robertson, 1908:261, (? part).
Membranipora lacroixii var. *triangulata,* O'Donoghue, 1923:25.
Conopeum reticulum, Harmer, 1926:211, synonymy and discussion.
Conopeum reticulum, Osburn, 1940:350-352, discussion.

Zoarium encrusting on various substrata. Zooecia of moderate size, usually about twice as long as the width but occasionally short and wide, usually ranging in length between 0.40 and 0.50 mm. There is a short gymnocyst (often vestigial), which typically bears a pair of triangular areas in the proximal corners. These triangular structures are at first open with a membranous covering, but later they often become closed and knob-like, or they may be fused into a single knob, often they are wanting, sometimes over considerable areas of a colony. They may be readily confused with the minute or vestigial avicularia of some species of *Antropora* but they are merely surface structures on the basal gymnocyst and are probably homologous with the basal tubercles of some species of *Membranipora.*

The opesia is elliptical, oval or rounded. The walls are rather heavily calcified and the descending cryptocyst coarsely granular, sometimes with conical points projecting laterally inward. Ovicells are wanting. Small avicularia have been mentioned by some authors, but I have never been able to find them in either Atlantic or Pacific specimens and I am inclined to believe the authors were mistaken or had some other species.

In the literature up to 1926 this species was generally confused with *lacroixi* Audouin, and most of the references are under that specific name.

Robertson's description and figure are inconclusive; she may have had this species or *Antropora tincta* (Hastings), which is much more abundant on the southern California coast, or both of them. O'Donoghue's record from British Columbia is probably correct for his variety *triangulata,* but the varieties *paucispina* and *multispina* doubtless refer to some other species, probably *Electra crustulenta* (Pallas).

This cosmopolitan species has been somewhat doubtfully recorded from Alaska to southern California, where Robertson states that it is "quite abundant."

It did not appear in the Hancock dredgings, but the writer has observed it in shore collections at Monterey Bay, Newport Harbor, and La Jolla, California. Mr. R. J. Menzies collected it at 5 fms in Tomales Bay, California, rather common, one specimen covering more than 8 square inches of the inside of a clam shell. Apparently it is not an abundant species and has been taken only in shallow water.

Genus **DESMACYSTIS** new genus

Zoarium encrusting. Zooecia thin walled; an extensive gymnocyst which is strengthened by a median carina and lateral transverse ribs. Opesia broad, its side walls extended laterally above the bases of adjoining zooecia. Cryptocyst apparently wanting. A median, sessile, transverse avicularium on the distal border of the gymnocyst. No ooecia; no spines; no dietellae. Genotype, *Membranipora sandalia* Robertson.

Where to place Robertson's *M. sandalia* has puzzled me greatly. It cannot remain in *Membranipora* since that genus, as now defined, has a very limited gymnocyst and no avicularia; *Electra* is suggested by the very extensive gymnocyst, but the presence of an avicularium and the total absence of spines apparently exclude *sandalia* from the genus; the absence of any form of ovicell seems to limit it to the simpler Membraniporidae, but it cannot be accepted in any modern genus of that group. The Membraniporidae (*sens str.*) are in so much need of careful, detailed revision, that it is with extreme hesitation that I inject another generic description into this difficult group.

Desmacystis sandalia (Robertson), 1900

Plate 3, fig. 1

Membranipora sandalia Robertson, 1900:324; 1908:264.

Zoarium encrusting, but not closely attached, forming fan-shaped colonies of a rather rough appearance. The zooecia are large, elongate, narrowed on the proximal half, length 0.85 (0.65 to 1.00) mm, width

0.40 (0.26 to 0.50) mm. Opesia variable in form and size (0.25 to 0.50 mm long by 0.25 to 0.45 mm wide), irregularly rounded or ovate and occupying approximately the distal half of the front. The mural rim flares outward on the sides over the bases of the adjoining zooecia. The proximal half, more or less, of the front is occupied by the extensive gymnocyst. When first formed this is smooth but soon a series of ribs (4 to 7 in number, with a median one which forms a sort of keel) grows inward from the border to become attached to the median keel; these ribs are apparently developed from the surface of the gymnocyst, as a part of it, and while they may have some resemblance to the costae of the cribrimorphs, they are in no sense homologous. There is no evidence of a cryptocyst. The frontal membrane is somewhat chitinized and the operculum (about 0.20 mm broad) has a heavier brown border.

The distal border of the gymnocyst bears a peculiar large, sessile, median, transverse avicularium with a short-triangular mandible which is hooked at the tip. There are no ooecia; no spines; no dietellae.

Robertson described the species from Yakutat, southern Alaska, and apparently it has not been noted since.

Our specimens are from Yakan Point, Queen Charlotte Islands, British Columbia, low tide, Dr. E. F. Ricketts, collector, three colonies.

Genus CUPULADRIA Canu and Bassler, 1919

The name *Cupularia* (*Cupulaire* Lamouroux, 1821), used to include species of *Cupuladria* and *Discoporella* for many years, has been shown by Hastings (1930:717) to be untenable. In 1919:77 Canu and Bassler established the genus *Cupuladria,* with *C. canariensis* Busk as the genotype, to include the membraniporid species with a wide open front.

Cupuladria canariensis (Busk), 1859

Plate 3, figs. 2 and 3

Membranipora canariensis Busk, 1859:66.
Cupuladria canariensis, Hastings, 1930:714.

Zoarium free, unilaminar; shaped like a cup or saucer, varying greatly in this respect, sometimes almost plate-like, at other times quite cupuliform; usually quite circular but occasionally elliptical or distorted. The zooecia are rhomboidal, as a rule very regularly arranged, each with a long chitinous flagellum at the distal end. The opesia is large, without any trace of a horizontal cryptocyst. The walls are thin and high, with a narrow descending cryptocyst which is distinctly granulated but which never bears spinules. The vibracula are very long and rather stiff and

often move in unison and when stimulated they may stand erect for some time. The vibracular chamber is prominent and its aperture is lunate, with one side higher than the other. The vibracula and the frontal membrane, especially near the walls, are brownish in color. The dorsal side shows small quadrangular areas with usually four pores in each area.

While the form of the colony and the arrangement of the zooecia are usually quite regular, exceptions are not uncommon. The larvae usually attach themselves to small objects, especially sand grains, and grow free and symmetrically beyond the edges, but occasionally they attach on larger irregular objects and become distorted. The *C. elongata* of Sakakura (1935:6) is an example of the same sort of irregularity in *C. guineensis* (Busk). The writer has a specimen of canariensis which became attached to the inside of a shell where it followed the curvature of the shell, becoming concave on the frontal surface.

This species appears to be limited to the Atlantic and the Mediterranean Sea and the Pacific coast of North America. It is an abundant form in the Gulf of Mexico, but it has hitherto escaped notice on the Pacific coast except for Hastings' record at Gorgona, Colombia. Robertson's record (1908:314) is due to a misidentification, as she undoubtedly had *Discoporella unbellata* (Defrance).

The range of the species on the Pacific coast, as determined by the Hancock dredgings, is from Cedros (Cerros) Island, half way down the coast of Lower California, to Ecuador and the Galapagos Islands. Intermediate stations, more than 30, include the Gulf of California, Clarion and Socorro Islands west of Mexico, the west coast of Mexico, Costa Rica, Panama, and Colombia. It occurs in shallow water and down to 40 fathoms, but appears to be more abundant from 10 to 20 fathoms.

Family **Electrinidae** d'Orbigny, 1851

The zoarium is usually encrusting, but may be erected from an encrusting base. The zooecia are usually provided with a well-developed gymnocyst but this is sometimes vestigial and both extremes may sometimes be seen on the same colony. There are no ovicells, no avicularia, and no dietellae. Spines are usually present around the border of the opesia, occasionally wanting, in some cases limited to a single strong median proximal spine which may be reduced to a mere tubercle or be very greatly elongated. The simple nature of the zooecia, except for the spines, relates this group to the more primitive membranipores.

ELECTRA Lamouroux, 1816

Genotype, *Flustra verticillata* Solander, 1786:15.

Key to the Species of *Electra*

1. No proximal spines, lateral ones long and numerous; the operculum bears a pair of long furcate, delicate chitinous spinous processes. *anomala*
 Proximal spines present (but see *crustulenta* var.). 2
2. A single median proximal spine. 3
 More than one proximal spine. 5
3. A single proximal spine only; operculum calcified, white. *crustulenta* var. *arctica*
 Lateral spines also present. 4
4. Proximal spine regularly present, strong; 1 to 4 pairs of weaker lateral spines, the distal ones erect. *hastingsae*
 Proximal spine weak or wanting, others slender and varying in number, often wanting; operculum weakly calcified. *crustulenta* var.
5. A transverse row of several stout proximal spines; a strong branched scutiform spine on each side of the operculum. . *biscuta*
 A long furcate spine on each side of the median proximal one, varying greatly. *bellula* var. *bicornis*

Electra crustulenta (Pallas), 1766

Plate 3, figs. 4 and 5

Eschara crustulenta Pallas, 1766:39.
Membranipora lacroixii, O'Donoghue, 1923:25 (? part).
Electra crustulenta, Borg, 1931:29.
Membranipora crustulenta, Osburn, 1944:31.

This species, which is common on both sides of the North Atlantic appears not to have been recorded definitely from the Eastern Pacific. The synonymy is so confused that it is not always possible to be certain of the reference. The work of Borg (1931, "On some species of *Membranipora*") has cleared up a great many points, especially concerning the numerous variations.

The zoarium is encrusting in a thin layer, often with narrow ramifying branches of one to several rows of zooecia. The zooecia are rather regular in distribution, elliptical in form, and separated by deep grooves. The walls are moderately thick as a rule, finely granulated on the mural rim and narrow cryptocyst. The smooth gymnocyst is often well developed, but under crowded growth conditions may be reduced to the vanishing point. The mural spines vary exceedingly, from none to as many as 6 on each side. The operculum is often more or less calcified and shows white against the rest of the frontal membrane.

Dr. Borg discusses six varieties, all but one of which were once considered species and in several of these the median proximal spine and the calcification of the operculum are wanting. Our specimens resemble the variety *baltica* in general appearance, but in the lack of the proximal spine and in the very weak calcification of the operculum they suggest the variety *stammeri* (See Plate 3, fig. 5).

Hancock Station 1478-42, Yaquina Bay, Oregon, on shells along shore. The species has also been taken at Dillon Beach, and Monterey Bay, California.

Electra crustulenta var. **arctica** Borg, 1931

Plate 3, fig. 4

This well-marked variety, characterized by a single strong spine in the midline proximal to the opesia, is abundant at Point Barrow, Alaska, G. E. MacGinitie, collector; at Punuk Island, Bering Sea; Nunivak Island, Nash Harbor, Alaska and south to Dillon Beach, California.

Electra anomala new species

Plate 3, fig. 6

Zoarium encrusting, thin and delicate. The zooecia are moderate in size, averaging about 0.50 mm in length by 0.30 mm in width, but there is a wide range in both dimensions; distinct with deep separating grooves; walls thin, the mural rim narrow and somewhat inflected, smooth or slightly granular. The gymnocyst is variable from one-fourth the zooecial length to almost wanting; cryptocyst not evident. The opesia is elliptical, narrowed at the base of the operculum, which is well chitinized. From the middle of the front surface of the operculum arises a pair of very elongate, bifurcate chitinous spines which extend far over the base of the distal zooecium; this anomalous condition is without parallel in the writer's experience.

At the distal end, on either side, is a short, stout, erect spine, which often appears to belong to the distal zooecium. The marginal spines are extremely variable; in the same colony the zooecia of the central area for several generations are spineless; there follows a narrow transitional zone in which there are a few spines, increasing in size and number outward; and finally a climax is reached with 8 to 10 long, slender spines on each side which bend low across the opesia until their points may pass each other; frequently these are briefly bifurcate at their tips, but there never appears to be any fusion of the tips. No avicularia; no ooecia; multiporous septulae are present in both lateral and distal walls.

In most of its characters it resembles *E. angulata* Levinsen (1909: 149) from Siam, but that species has an evident cryptocyst, shorter, simple spines, and lacks the extraordinary opercular decoration of *anomala.*

Type, AHF no. 12.

Type locality, Balboa, Canal Zone 8 colonies encrusting wood, the largest 20 mm in diameter. The specimens were received from the W. F. Clapp Biological Laboratories.

Electra biscuta new species

Plate 3, figs. 7 and 8

Zoarium thin, encrusting shells, the colonies small.

Zooecia small (length 0.26 to 0.30 mm, width 0.18 to 0.22 mm), distinct with well-marked grooves. The gymnocyst is usually very limited, but may occupy one-fourth or more of the zooecial length; cryptocyst narrow, not expanded, smooth or finely granulated; the mural rim low, thin and slightly granulated. The distal wall is strongly arched forward on the dorsal side. The opesia is irregularly ovate, straighter on the proximal border and conspicuously narrowed in the region of the operculum; occasionally more elliptical.

The spines are heavy, broad at the base and without joints and are of three kinds: (1) a broad spine, often cervicorn with three points, sometimes only bifid or again simply broadened; these are situated one on each side of the operculum and when fully developed bend across the opesia like a pair of scuta; (2) just distal to these on each side is a short, stout, conical, erect spine opposite the distal end of the operculum; (3) on the gymnocyst immediately proximal to the opesia is a transverse series of short, stout conical spines which project forward in a row at a slight angle above the opesia, these usually number 3 or 4 but vary from 1 to 5; often their bases are more or less fused, and their tips often briefly bifurcate.

The generic relationship of this species is somewhat in doubt. No ooecia have been observed and there are no avicularia. The communication pores are in the form of round multiporous rosette plates. The absence of ooecia and avicularia and the presence of a gymnocyst, mural spines and thin lateral and dorsal walls, without dietellae, suggest the genus *Electra,* though there is little resemblance in appearance to any others of that genus.

Type, AHF no. 13.

Type locality, Mazatlan, Mexico, 23°19′00″N, 106°23′00″W, intertidal, two colonies, Miss A. E. Blagg, collector. Also taken at Hancock Station 341, three colonies, Secas Islands, Panama, 7°53′10″N, 82°12′05″W, 30 fms.

Electra bellula var. bicornis (Hincks), 1881

Membranipora bellula var. a (*bicornis*) Hincks, 1881a:149.
Electra bellula var. *bicornis,* Hastings, 1930:706.

This is a thin-walled, rather delicate species with a small, short, median spine proximal to the opesia. The variety *bicornis,* in addition to the median spine, has a longer forked or branched spine on either side of the central one, bending forward over the opesia, (the median spine sometimes wanting).

The species and variety have a wide distribution. It did not occur in the Hancock dredgings, but Dr. Hastings has recorded it from the Galapagos Islands.

Electra hastingsae Marcus, 1938

Electra hastingsae Marcus, 1938:17, synonymy.
Electra monostachys, Hastings, 1930:706.
(Not *Membranipora monostachys* Busk, 1854, and numerous later authors).

This species has been confused with *Electra* (*Membranipora*) *crustulenta* (Pallas), the variety with a single proximal spine, which it resembles, but in that form there is a well-calcified operculum often of striking white appearance, while in *hastingsae* the operculum is entirely membranous. There is usually a pair of small distal spines opposite the operculum and some small marginal spines; the single proximal spine is smaller and not as much enlarged at the base as in *crustulenta.*

This species was not found in the Hancock collections, but Hastings recorded it from Balboa, Canal Zone, along shore. It is a common species along the shores of western Europe and eastern North America, and Marcus records it from Santos Bay, Brazil.

Family Flustridae Smitt, 1867

The zoarium is erect, free, frondose and flexible with little calcification (rarely encrusting and loosely attached). Zooecia membraniporine, the opesia occupying all or nearly all of the front; walls thin, usually with uniporous septules. Avicularia interzooecial, usually simple and

primitive (wanting in some genera). Ooecia, when present, endozooecial and embedded either in the base of the succeeding zooecium or in an avicularian chamber. Levinsen, 1909:122-125, and Silen, 1941:49-54, have presented the best discussions and analyses of this family and have erected a number of new genera.

Silen, 1941:49-54, retains the old genus *Carbasea* Gray for species with unilaminar zoaria which lack both aviacularia and ooecia. He erects a new genus, *Terminoflustra,* for the species with squared avicularian chambers, which are located at the bifurcation of zooecial rows, the genotype being *Flustra barleei* Busk. The genotype of *Carbasea* is *Flustra carbasea* Solander.

Genus **CARBASEA** Gray, 1848

The zoarium is frondose with lobate branches, unilaminar. There are no avicularia and no ooecia.

Carbasea carbasea (Solander), 1786

Plate 3, fig. 9

Flustra carbasea, Hincks, 1880:123.

The zoarium is usually a broad, thin, sheet, more or less subdivided into lobes, with a narrow short stalk which is attached by a narrow base. There is a single layer of zooecia, all facing the same direction. The zooecia are large, 0.90 to 1.25 mm long and about 0.40 mm wide, in quite regular alternating series, the narrow base of one between the expanded distal halves of those on either side; the walls thin and the distal wall strongly curved forward; opesia occupying all of the frontal area, with sometimes a slight development of a proximal cryptocyst. No spines; no avicularia; no ovicells.

The "Lawn Sea-mat" of Ellis and Solander's Zoophytology is a common high-northern species in the North Atlantic and adjacent Arctic Ocean. Recorded frequently from Spitzbergen south to the British Isles and west to Greenland, Osburn (1932:7) extended its range to Loubyrne, Hudson Bay. It now appears in collections from Alaska and no doubt is circumpolar in distribution.

Dall Alaska Collection 3623-1670, U. S. National Museum, and Albatross Collection, Cordova, Alaska, June 28, 1914, Common at Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector.

Genus TERMINOFLUSTRA Silen, 1941

Avicularia squared and situated at the bifurcations of zooecial rows; ooecia endozooecial, embedded in the bases of the succeeding zooecia. Genotype, *Flustra barleei* Busk, 1860:120.

Terminoflustra membranaceo-truncata (Smitt), 1867

Plate 3, fig. 10

Flustra membranaceo-truncata Smitt, 1867:358.
Flustra membranaceo-truncata, Robertson, 1905:292.
Flustra membranaceo-truncata, O'Donoghue, 1923:24; 1926:47.

The zoarium is erect and consists of irregularly flabellate fronds, unilaminar and thin. The zooecia are irregularly quadrate or elongate-hexagonal, truncate at both ends, usually narrower at the proximal end. The walls are thin, with a minute spine, often wanting, at each distal corner. The avicularia, which are rather rare, are usually situated at the bases of new rows of zooecia; nearly square in outline and about one-third as large as the zooecia; the mandible is semicircular, directed distally, with a continuous chitinized border.

Ooecia endozooecial, embedded in the bases of the succeeding zooecia, small, inconspicuous except in transmitted light.

Circumpolar. Robertson recorded it from the Pribilof Islands, Bering Sea; O'Donoghue listed it from Banks Island and China Hat, in British Columbia waters.

In studying the material from the U. S. Alaska Crab Investigation, I find two small colonies from Alitak Bay, Alaska, at 30 fms.

Family Hincksinidae Canu and Bassler, 1927

This family includes membranipores of simple structure, similar to the Membraniporidae except for the presence of an endozooecial ovicell. The ovicell is usually a narrow, transverse, shallow structure, opening widely into the zooecial cavity and closed by the operculum, but sometimes it is merely a rounded expansion of the zooecial cavity into the base of the succeeding zooecium. Spines, avicularia, and dietellae may be present.

Key to Genera of Hincksinidae

1. No avicularia, no dietellae. *Aplousina*
 One or both of these present. 2
2. Tall pedunculate avicularia among the spines. . . *Cauloramphus*
 Avicularia sessile, vicarious. 3
3. Avicularia usually paired at the proximal corners, cryptocyst strongly developed. *Antropora*

Avicularia not paired, or if paired they are on the lateral walls; cryptocyst less developed. 4
4. Avicularia large, or paired on the lateral walls; ovicells small but evident on the surface. *Hincksina*
Avicularia single at distal ends of zooecia, ovicells not evident on the surface. 5
5. Mandible very long and winged. *Cranosina*
Mandible short, pointed, not winged. *Ellisina*

Genus HINCKSINA Norman, 1903

Zooecia encrusting, entire area membranous, mural rim with or without spines. Ovicell endozooecial, occasionally conspicuous but usually small, short and sometimes scarcely evident. No dietellae. Avicularia usually interzooecial. Genotype, *Membranipora flustroides* Hincks, 1880.

Key to Species of *Hincksina*

1. Avicularian mandible very elongate. 2
Mandible not extremely elongate. 4
2. Mandible setiform and winged on both sides. *alba*
Mandible not winged. 3
3. With numerous spines bending over the opesia. *pallida*
Spines wanting. *pacifica*
4. Avicularia lateral and paired. *nigrans*
Avicularia not lateral and not paired. 5
5. Mandible triangular, usually with one side longer than the other. *velata*
Mandible semicircular. 6
6. Numerous spines bending low over the opesia. . . . *polacantha*
No spines. *minuscula*

Hincksina alba (O'Donoghue), 1923

Plate 5, fig. 2

(*Membranipora alba*), O'Donoghue, 1923:28.
Callopora alba, O'Donoghue, 1926:34.

Encrusting, white to light yellow. Zooecia large, 0.75 to 1.08 mm long by 0.40 to 0.55 mm wide; walls high, rather thick and conspicuously elevated on the distal border; opesia oval and occupying nearly all of the frontal surface, 0.55 to 0.65 mm long; gymnocyst small; cryptocyst limited to the border of the opesia, granular and minutely crenate at its lower edge. The operculum is large, about 0.20 mm in either dimension, with a conspicuous yellow bordering sclerite.

The avicularium is vicarious, taking a place in the zooecial series, and has the appearance of a symmetrical onychocellarium; it is nearly as long

as a zooecium, but much narrower, only 0.26 to 0.30 mm in width; its opesia is elliptical and partially divided near its middle, the border of the proximal portion minutely crenate. The mandible is very elongate, usually about 1 mm, the rachis slender and without denticles, strongly curved downward near the tip, the base is triangular, about 0.20 mm wide, and is hinged to the frontal surface of the chamber; the rachis is winged equally on both sides, continuing nearly to the curved tip.

The ovicell is high and prominent, transverse, 0.35 to 0.40 mm wide by 0.20 mm long, endozooecial and closed by a special membrane, occasionally there is a small tuberosity on the top.

Dietellae are present in the lateral walls and multiporous septulae in the distal wall.

O'Donoghue described the species under *Membranipora* and changed it later to *Callopora.* However, the ooecia are definitely endozooecial, as shown by dissection, and the species is here transferred to the genus *Hincksina.* Recorded from off Protection Gap and Schooner Bay, British Columbia, down to 30 fathoms.

In the Hancock collections there are several colonies on a shell labelled "local," but without further data. Also off Santa Catalina Island, southern California, on a brachiopod shell.

Hincksina nigrans (Hincks), 1882

Plate 5, fig. 5

Membranipora nigrans Hincks, 1882:248.
Membranipora macilenta Jullien, 1802:25.
Membranipora macilenta, Waters, 1900:61.
Callopora nigrans, Osburn, 1919:608; 1923:8; 1932:8.
Adenifera nigrans, Canu and Bassler, 1920:102.

Zoarium encrusting, coarse, light brown to nearly black. The zooecia are large, 0.70 to 1.00 mm long by 0.45 to 0.55 mm wide; distinct; mural rim raised and granulated, the distal wall arched forward and its rim somewhat elevated; opesia occupying nearly all of the front; gymnocyst vestigial; cryptocyst sometimes forming a narrow proximal shelf, but often not evident. Large multiporous septules are present, usually two in the distal wall and the same in each half of the lateral wall, but more rarely some uniporous septulae are found. Small lateral avicularia are present on practically all of the zooecia, one on each side opposite the distal end of the operculum, the rostrum elevated and the triangular mandible directed backward. No spines.

The endozooecial ovicell is very shallow, inconspicuous and is formed by the elevation of the distal mural rim, closed by a special membrane. The position of the ooecium is rendered very conspicuous by the development of a thick-walled, bilobate ooecial cover which rises from the base of the succeeding zooecium. This structure resembles the ooecial cover in the genus *Tegella,* as it does not fuse with the ovicell, but it is not developed in connection with an avicularium and there is a dumb-bell-shaped membranous area on the top. The infertile zooecia do not possess this structure, but it appears on every ovicell. The center of the colony presents an altogether different appearance from the fertile area. In the infertile zooecia the operculum extends to the distal wall, but in the fertile ones it is somewhat remote and the frontal membrane distal to it appears to rise to close the ovicell.

The *M. macilenta* of Jullien and Waters is merely the infertile stage of *nigrans.* Osburn followed Nordgaard in placing *nigrans* in the genus *Callopora,* but the endozooecial ovicell and the lack of pore chambers preclude that association. Canu and Bassler included it under their genus *Adenifera,* but it definitely has a small ooecium and otherwise differs from *Biflustra armata* Haswell, which is the genotype of *Adenifera.* Because of the nature of the ovicell this unusual species appears to conform more nearly to the definition of the genus *Hincksina.*

Hincks described the species from the Houston Stewart Channel, British Columbia. Jullien's record of *macilenta* from north of Spain, and Waters' from Wilczek Land refer to the young stage. Osburn has recorded it from Etah, Greenland; Port Burwell, Ungava, Canada, and from the Canadian Arctic Expedition Sta. 23, 70°24′N Lat., 161°25′W Long. It is doubtless another circumpolar species.

Dall, Alaska collection, 1623-1670, one mature colony on a shell. It is abundant at Point Barrow, Alaska, at 18 to 25 fms, G. E. MacGinitie, collector, Alaska Research Laboratory.

Hincksina pacifica new species

Plate 5, fig. 1

Zoaria encrusting on shells, white to light yellow in color. Zooecia moderately large (0.55 to 0.80 mm long), distinct; opesia occupying nearly all of the front, oval or elliptical; mural rim somewhat thickened, finely beaded, the narrow descending cryptocyst similar in texture; gymnocyst vestigial. Operculum thin, semicircular, with yellow bordering sclerite. Avicularia vicarious, scattered, the chamber more or less rhombic in form, sides of the rostrum thin and elevated, the narrow tip often

projecting above the succeeding zooecium; mandible elongate-triangular, symmetrical, 0.30 to 0.40 mm long by 0.18 mm wide at the base, yellow with a bordering sclerite, the tip much decurved and ending in a fine point; attached by a pair of cardelles.

Ovicell endozooecial, but moderately prominent, short and transverse (semilunate), the surface slightly roughened, but without an umbonate process. Dietellae present. No spines.

It is apparently very similar to *H. pallida* (Hincks) but that species is well provided with spines, both erect and curved, and the ovicells, according to O'Donoghue (1926:31) are so immersed as to be invisible on the surface. It is also related to *H. velata* Hincks but in that species the avicularium is shorter and the ovicell has a different form.

Type, AHF no. 14.

Type locality, Albatross Station 2984 near the Guadalupe Islands off Lower California, 28°57′15″N, 118°15′45″W, at 113 fms, two colonies.

Hincksina velata (Hincks), 1881

Plate 5, figs. 3 and 4

Membranipora velata Hincks, 1881:130.

Callopora triangulata O'Donoghue, 1926:35.

The description and figure by Hincks (pl. 5, fig. 3) and that of O'Donoghue (pl. 3, fig. 28) agree in practically every detail and are correct with one exception. In spite of Hincks' figure and the statement by O'Donoghue, the ovicell is not hyperstomial but endozooecial, as both dissection and growth stages show no mural rim beneath the aperture of the ovicell; the latter is very definitely closed by the operculum, and the cavity is formed by the forward extension of the upper part of the distal zooecial wall.

The figure by Hincks shows the avicularian mandible curved while that by O'Donoghue represents it as straight, but both conditions may occur in the same colony and it is often slightly asymmetrical, one side being longer than the other. There are two very strong hinge denticles. Measurements were not given, but in our material the zooecia measure 0.60 to 0.70 mm long by 0.35 to 0.50 mm wide, and the opesia 0.40 to 0.50 mm long by 0.30 to 0.35 mm wide. The ovicell is at first transverse and arcuate, but assumes a triangular form by additional calcification. The opesia occupies most of the frontal area; the walls rather thick and granulated; gymnocyst present but often much reduced; spines wanting, dietellae present; avicularia vicarious.

Hincks described the species from Santa Cruz, California, and O'Donoghue lists *triangulata* from "Gabriola Pass; Brotchie Ledge, Victoria, B.C."

Hancock Stations: 1187-40 and 1325-41, off Santa Catalina Island, 1269-41, Anacapa Island, California; 2167, Dewey Channel off Point San Eugenio, and 2168, Cabeza Ballena, Lower California, and 431-35, off Octavia Rocks, Colombia. The known range is therefore from British Columbia to Colombia, and down to 60 fms.

Hincksina pallida (Hincks), 1884

Plate 23, fig. 2

Membranipora pallida Hincks, 1884:39.
Membranipora acifera form *multispinata* Hincks, 1884:8.
Membranipora pallida, O'Donoghue, 1923:25.
Hincksina pallida, O'Donoghue, 1926:31.

Zoarium loosely attached by dorsal processes, thin. Zooecia elongate, elliptical, length 0.60 to 0.70 mm, width 0.25 to 0.30 mm; gymnocyst and cryptocyst vestigial; the walls thin and smooth, beset with 5 to 8 slender, pointed spines which bend somewhat over the opesia, except the most distal pair which are erect. Avicularia appear at the base of many of the zooecia, the chamber more or less quadrate, the mandible broad at the base and tapering rapidly into a very long acicular point; at first glance the avicularia appear to be mounted on the zooecial base, but their mode of development shows them to be interzooecial, and the extent of their chambers can readily be seen on the dorsal side. The mandibles average 0.35 mm in length, with a strongly decurved tip.

The ooecia are endozooecial, low and inconspicuous, cucullate with a wide aperture, 0.18 mm wide by 0.10 mm long.

Hincks first considered this to be a form of *M. acifera* MacGillivray, but later described it as a new species; his discussion and figure (pl. 19, fig. 4) are good but he did not have the ovicell and did not discuss the nature of the avicularian chamber (Virago Sound, British Columbia). O'Donoghue discovered the ovicell and removed the species to *Hincksina* (a number of localities in British Columbia, the San Juan Islands northward). Neither Hincks nor O'Donoghue mentions the peculiar mode of attachment which is by means of a short chitinous tube growing from the middle of the dorsal side of many of the zooecia.

Hancock collections,—a number of colonies dredged near Friday Harbor, Puget Sound, Dr. J. L. Mohr, collector.

Hincksina polacantha O'Donoghue, 1926

O'Donoghue, 1926:31.

Zooecium oval, elongate; margin slightly raised. As a rule there are two pairs of small erect distal spines, and on each side 10 to 13 longer spines which curve over the aperture and overlap in the midline. The aperture is completely membranous. Ooecium a marked dilatation, a little more than a hemisphere, free from ridges or perforations. Apparently it is of the separated endozooecial type. (After O'Donoghue).

O'Donoghue questions somewhat the generic relationship on account of the prominence of the ooecium and it may be that the species should be referred to *Callopora.* It is reported only from Snake Island, British Columbia, and did not appear in the Hancock dredgings.

Hincksina minuscula (Hincks), 1884

Membranipora minuscula Hincks, 1884:11.
Hincksina minuscula, O'Donoghue, 1926:30.

Zooecia small, oval; margin a good deal raised, thin, smooth, no spines; on an oblong area, placed above the cell, occasionally a small circular avicularium, slightly raised, the mandible directed upward. Ooecium semicircular, shallow, just covering the extremity of the cell, smooth, with a subcircular membranous space at the back (? avicularium). (Condensed from Hincks.) O'Donoghue adds the information that the "membranous space" on the ovicell is usually occupied by an avicularium, though this structure is occasionally separated from the ooecium.

Described by Hincks from Houston Stewart Channel and listed by O'Donoghue from Gabriola Pass and Bentinck Island, British Columbia. It did not appear in the Hancock dredgings.

Genus APLOUSINA Canu and Bassler, 1927

The genus is characterized by the presence of endozooecial ovicells and the absence of spines, avicularia and dietellae (pore chambers). The zooecial walls are vertical and thin, with the mural rim and the very narrow cryptocyst slightly beaded. Proximally the cryptocyst usually merely rounds out the corners at the proximal end, but in narrower zooecia it may extend a short distance. There is a single multiporous communication pore in the distal wall and two or three in the lateral wall. Jullien figured *A. (Membranipora) filum* with a pair of vestigial

spines but these are usually wanting. The characters therefore are those of a simple membranipore except for the endozooecial ovicell. Genotype, *Aplousina gigantea* Canu and Bassler, 1927.

Aplousina filum (Jullien), 1903

Plate 4, fig. 1

Membranipora filum Jullien, 1903:41
Biflustra lacroixii, Smitt, 1873:18.
Aplousina filum, Canu and Bassler, 1930:5 (synonymy).

Zoarium encrusting shells. The zooecia are distinct, rounded, ovate or elliptical; varying greatly in their dimensions, ranging in lengths from 0.60 to 0.80 mm and in width from 0.40 to 0.55 mm, shorter zooecia usually being wider. The walls are thin, the cryptocyst usually a mere granulated border but sometimes a little broader proximally; gymnocyst small or wanting; the opesia occupying nearly all of the front. A minute pointed spine is rarely present on the mural rim at each side of the operculum. No avicularia.

The ovicell is endozooecial but prominent, lunate, the aperture wide and closed by a special membrane; about 0.25 mm wide by 0.14 mm long, very finely granulated.

Known from the eastern Atlantic region, from the Gulf of Mexico (*Biflustra lacroixii,* Smitt, non Audouin), and from the Galapagos Islands, Albatross Sta. D. 2813 (Canu and Bassler).

Hancock Stations: 557-36, Isla Partida and 267, San Esteban Island, Gulf of California; 328, Cocos Island, Costa Rica; 431-35, Octavia Rocks, Colombia; 155-34, Albemarle Island and 788-38, Daphne Major Island, Galapagos; 14 to 60 fms.

Aplousina major new species

Plate 4, fig. 2

The zoarium forms a thin yellowish or brownish crust on shells. Zooecia very large, averaging in length about 0.90 mm (range 0.80 to 1.20 mm) and in width about 0.70 mm. There is great variation in the shape, as wide as long to twice as long as wide. A narrow brown line separates the mural rims which are thin and beaded all around the border except that the distal rim is sometimes smooth. The opesia occupies all of the front; gymnocyst wanting; cryptocyst narrow, descending sharply, often scarcely evident. The chitinous ectocyst is unusually thick, yellow to brownish in color; the operculum very large (0.25 mm wide), thicker

and browner toward the border, and the border of the aperture is also thick and brown. Dietellae present. No spines, no avicularia.

The ovicell is inconspicuous, transverse, very shallow, smooth or becoming roughened, or with a small median callosity.

This species resembles *A. gigantea* Canu and Bassler (1928:20) from the Gulf of Mexico, but it is even larger and the operculum is much larger (0.20 mm wide in *gigantea*). It is still larger than in *A. filum,* the other species from the Pacific coast.

Type, AHF no. 15.

Type Locality, Hancock Station 1271-41, off Anacapa Island, southern California, 33°59′50″N, 119°24′30″W, 26 fms. Also Stations 1284-41, Santa Rosa Island, and 1190-40, Anacapa Island, southern California; 275-34, Tenacatita Bay, Mexico, and 810-38, Barrington Island, Galapagos, 15 to 48 fms. The type colony from Anacapa Island, southern California, measured about 50 mm across, practically covering a dead shell.

Genus **CRANOSINA** Canu and Bassler, 1933

The ovicell is endzooecial. A setiform transverse avicularium surmounts each zooecium. The dietellae are extremely conspicuous and about four in the distal half of the lateral wall, their openings to the zooecia often large. Genotype, *Membranipora coronata* Hincks, 1881 (after Canu and Bassler).

The genus is here referred to the Family Hincksinidae with endozooecial ovicells.

Cranosina colombiana new species

Plate 4, fig. 3

Zoarium encrusting on shell, thin and white. Zooecia elongate ovoid, varying considerably in form and size, average length 0.55 mm (0.50 to 0.65), width 0.30 mm (0.25 to 0.40); separated by narrow grooves; mural rim thin, beaded in advanced calcification, slightly more elevated distally; gymnocyst and cryptocyst usually vestigial. There are 4 or 5 weak spines on each side, somewhat curved over the opesia, but no distal spines.

At the distal end of each zooecium (occasionally wanting) and occupying a position in the zooecial series, is an avicularian chamber, usually more or less square and measuring about 0.15 mm in each dimension, though there is much variation in the size. The avicularium is transverse, the mandible decurved strongly (sometimes slightly curved side-

ways also), triangular at its base and much narrowed beyond, never longer than the breadth of the opesia and not winged; the mandible is attached by prominent hinge teeth.

There is no external indication of ovicells except a slight elevation and thickening of the distal rim. The dietellae are large and open widely.

Spines are not known in the other species which have been assigned to this genus, but the nature of the avicularium and the endozooecial ovicells seem to place the present species in *Cranosina* without question. It resembles *C. coronata* (Hincks) in general appearance, but in *coronata* the mandible is very elongate (nearly as long as the zooecia) and winged, and there are no spines. It also resembles *Copidozoum transversum* Silen (1941:41), which may have to be placed in *Cranosina,* but it is evidently a different species.

Type, AHF no. 16.

Type locality, Hancock Station 431-35, off Octavia Rocks, Colombia, 6°47′20″N, 77°41′40″W, at 45 fms, several colonies on pebbles.

Genus **ELLISINA** Norman, 1903

Ellisina Norman, 1903: 596.
Ellisinidra Canu and Bassler, 1933:18.
Ellisina, Hastings, 1945:87.

Genotype, *Membranipora levata* Hincks, 1882:249. "Zooecia membraniporine, ovicells endozooecial and closed by the zooecial operculum, avicularia vicarious and pointed, pore chambers present. It appears that the ovicell may be immersed in a kenozooecium (*E. levata*), a vicarious avicularium (*E. antarctica*) or an autozooecium (*E. incrustans*)" (Hastings, 1945:87).

The above description may now stand for this genus, which has been much misunderstood even by its original author. Norman erected the generic name, giving *levata* Hincks from the Queen Charlotte Islands as the genotype, but unfortunately drew his description from a Gulf of St. Lawrence specimen which was misidentified and which belongs elsewhere. Norman's description of the genus is therefore in error, but his selection of *levata* as the type definitely attaches the name *Ellisina* to the species *levata.* Hastings (1930:713) pointed out Norman's error in identification, but wrongly accepted his description as fixing the generic name to the St. Lawrence specimen. More recently Hastings (1945:87) has corrected her error because "a genotype explicitly named in the introduction of a genus must stand despite any such discrepancies in the defi-

nition." In the meantime Canu and Bassler (1933:18) mistakenly renamed the genus *Ellisinidra* with *levata* Hincks as the genotype. These authors apparently did not examine material of *levata* since they indicate that the "ovicell is hyperstomial."

The avicularia are definitely members of a zooecial series, each one arising at the distal end of the preceding zooecium. This is clearly shown at the margin of the zoarium where a complete zooecium is followed by a developing avicularian chamber. Avicularia are usually present distal to the zooecia but they are sometimes absent and the latter condition seems to negate the supposition of Canu and Bassler that "they are necessary in the opening of the opercular valve."

Ellisina levata (Hincks), 1882

Plate 4, fig. 4

Membranipora levata Hincks, 1882:249; 1884:10.
Ellisinidra levata, Canu and Bassler, 1933:18.
Ellisina levata, Hastings, 1945:87.

Zoarium encrusting, smooth, white. Zooecia of moderate size (length 0.40 to 0.53 mm and width 0.25 to 0.30 mm), very distinct with broad separating grooves. Gymnocyst small and smooth, cryptocyst narrow, thin and slightly granulated. Opesia oval or elliptical, occupying nearly all of the frontal area, the walls thin and the mural rim smooth, no spines. Pore chambers present. The avicularia are interzooecial, the chambers go down to the level of the dorsal side and each chamber has a large distal pore connecting with the next distal zooecium. The chamber is more or less square (0.10 to 0.13 mm in either dimension), the avicularium mounted near the middle of the frontal surface, the rostrum elevated and the triangular mandible directed transversely (with some variation).

According to Hastings, who has examined the type material, the ovicell is endozooecial and embedded in a kenozooecium (avicularian chamber without an avicularium), and is closed by the zooecial operculum.

While this species has been the subject of so much discussion, it apparently has been known only from Hincks' material, "Houston Stewart Channel, 15-20 fathoms; Cumshewa; very abundant," British Columbia.

Hancock Station 1064, off Santa Barbara Island, California, 27 fms, one colony on a shell, not in reproduction.

Genus ANTROPORA Norman, 1903

Antropora Norman, 1903:87.
Membrendoecium Canu and Bassler, 1917:17.
Dacryonella Canu and Bassler, 1917:28.
Antropora, Harmer, 1926:232.
Canua Davis, 1934:215.
Antropora, Marcus, 1937:50.
Antropora, Silen, 1941:43.

Norman indicated the heavy cryptocyst, surrounding the aperture; the paired avicularia at the distal ends of the zooecia; the presence of dietellae, and the genotype, *Membranipora granulifera* Hincks. Harmer's description is more complete, adding the fact that the ovicells are endozooecial and vestigial and that the avicularia do not always face each other. However, he refers to the avicularia as "adventitious" which is incorrect since dissection proves them to be interzooecial.

I am unable to draw any line of distinction between *Antropora, Membrendoecium* and *Dacryonella,* and *Canua* is merely a new name for *Membrendoecium* which was improperly founded and which Canu and Bassler have corrected. In all of these the cryptocyst is heavy, broad proximally and continued, at least narrowly, around the aperture; the ovicell is endozooecial and vestigial; all have small interzooecial avicularia at or near the proximal corners; all are provided with dietellae, and all are heavily calcified.

Dacryonella has a large cryptocystal lamina, but not larger than it often is in some species that have been allotted to *Antropora* and *Membrendoecium,* and it has the same form. The avicularia of *Antropora* are not "adventitious," as stated by Norman and Harmer, since both dissection and the manner of development at the growing edge prove them to be interzooecial in origin.

Antropora granulifera (Hincks), the genotype, occasionally has larger interzooecial avicularia, and this is also true of other species, such as *A. (Crassimarginatella) tincta* (Hastings), *A. (Membrendoecium) claustracrassa* (Canu and Bassler), *A. (Membrendoecium) compressa* (Osburn) and *A. (Crassimarginatella) leucocypha* (Marcus). None of the above species have the hyperstomial ovicell and the type of avicularium with a complete hinge bar of *Crassimarginatella crassimarginata* (Hincks).

Through the kindness of Dr. R. S. Bassler, who has shown similar courtesies on many occasions, the writer has had the opportunity to make

dissections of both fossil and recent types of *Dacryonella* (*D. octonaria* Canu and Bassler, *D. typica* Canu and Bassler and *D. trapezoides* Canu and Bassler), all of which show the fundamental characters of *Antropora*. Marcus (1937:50) placed *Dacryonella minor* (Hincks) under *Membrendoecium;* Osburn (1940:358) placed *Dacryonello typica* Canu and Bassler in *Canua (Membrendoecium)*, and Silen (1941:43) comes to the conclusion that *Membrendoecium* "cannot be kept apart from *Antropora.*"

KEY TO THE SPECIES OF *Antropora*

1. Avicularium with a triangular mandible. 2
 Avicularium with a semicircular or very slightly triangular mandible, small but varying greatly in size, not regularly oriented, usually minute and vestigial. *tincta*
2. Avicularia with a triangular mandible, usually paired and directed forward, frequently vestigial and often wanting on one or both sides. *claustracrassa*
 Avicularia with acute triangular mandible, usually paired and directed toward each other across the proximal end of the zooecium, occasionally vestigial or wanting. . . . *granulifera*

Antropora granulifera (Hincks), 1880

Plate 4, fig. 5

Membranipora granulifera Hincks, 1880a:72.
Antropora granulifera, Norman, 1903:87.
Antropora granulifera, Harmer, 1926:232.
Antropora granulifera, Hastings, 1930:714.

Zoarium encrusting. Zooecia variable in size, but usually from 0.35 to 0.40 mm long by 0.25 to 0.30 wide; outlined by a thin mural rim; walls heavily calcified. Gymnocyst vestigial; cryptocyst thick and coarsely granulated, extending for about half the length of the zooecium and continued around the aperture; opesia subtriangular, its proximal border straight or slightly arched, the sides contracted slightly opposite the opercular attachment. The small avicularia vary somewhat, but characteristically there is a pair immediately distal to each zooecium, the mandibles sharply triangular, the rostra slightly elevated and directed toward each other, their points frequently touching. Norman (p. 88) describes them as "in the extreme upper part of the zooecium." Harmer (p. 233) considers them to be "proximal avicularia belonging to the succeeding zooecium." However, they do not "belong" to either zooecium, and dissection and development at the growing edge both show them extending to the dorsal wall, and at the edge the young avicularian

chamber can be seen to develop separately before the zooecium distal to it is calcified. They are therefore definitely interzooecial in origin, whatever their later surface relations may appear to be. They are not always paired, especially near the center of the zoarium, nor are they always directed toward each other.

The ooecia are vestigial, represented by a small transverse rib between the avicularia. Dietellae are present.

Probably distributed around the world in warmer waters; Madeira and Cape Verde Islands; Indian Ocean; Ceylon; Japan; East Indies at various localities; and recorded by Hastings from Jicaron Island, Panama. It has not been noted on the Atlantic coast of the Americas.

Hancock Station 264, south of White Friars Islands, off Petatlan Bay, Mexico, 25 fms, on a shell, and 457-35, Secas Islands, Panama, 12 fms, on shells; also, Gulf of Panama, Galtsoff collection, on pearl oysters.

Antropora claustracrassa (Canu and Bassler), 1930

Plate 4, fig. 6

Membrendoecium claustracrassum Canu and Bassler, 1930:7.

The zoarium encrusts shells, corals and coralline nodules, multilaminar, white and glistening. The zooecia are of moderate size, about 0.40 to 0.50 mm long, but there is much variation; distinct with deep furrows; mural rim thin; cryptocyst granular, broad proximally and extending on the sides along the operculum, crenulated on the inner margin. Opesia oval, the distal end narrower. At the proximal end there is, on one or both sides, a small interzooecial avicularium with a triangular mandible which is usually directed straight forward. From their position the avicularia often appear to be frontal, especially when only one is present, but disssection shows the minute cavity of the chamber extending to the level of the dorsal side.

The ovicell is small, endozooecial and scarcely noticeable, but the operculum of the fertile zooecium is considerably larger and more heavily chitinized. Small dietellae are present. There are no spines, but occasionally small nodules occur in place of avicularia. The ancestrula is only about half as large as the later zooecia, but the "false ancestrulae" of the secondary lamina are noticeably larger than the ordinary zooecia.

Canu and Bassler described the species from the Galapagos Islands. The present work shows it to be a common species, ranging from Guaymas, Mexico, 27°56′N Lat. to La Libertad, Ecuador and the Galapagos Islands.

Hancock Stations: 143-34, Wenman, 155-34, Albemarle, and 170-34, Chatham Islands, Galapagos; 212-34, La Plata, and 12-33, La Libertad, Ecuador; 411-35, Gorgona Island, Colombia; 298-34, Clarion Island, west of Mexico; 276-34, Tenacatita Bay, Mexico; 283-34 and 286-34, Thurloe Head, west cost of Lower California; 591-36, Puerto Escondido, 659-37, Agua Verde Bay, and 1088, Ensenada de San Francisco, Gulf of California; from shore to more than 100 fms.

Antropora tincta (Hastings), 1930

Plate 4, fig. 7; plate 29, figs. 7 and 8

Crassimar ginatella tincta Hastings, 1930:708.
Membranipora lacroixii Robertson, 1908:261, (in part).

The zoarium encrusts shells especially and on dead gastropod shells inhabited by hermit crabs it sometimes develops erect irregular branches as much as 50 mm in height; multilaminar to a high degree; color ranging from white in younger stages through light pink to pinkish-brown. The zooecia are irregularly oval, with one or two triangular or somewhat rounded areas at the proximal end of each zooecium (vestigial avicularia), the appearance being similar to that of *Conopeum (lacroixii) reticulum*. The areas, however, are not developed on the gymnocyst, as dissection shows a tube descending to the dorsal side. Small functional interzooecial avicularia are scattered irregularly among the zooecia in a similar position, or replacing a zooecium at the beginning of a series; they are often wanting over large areas, or there may be several of them in the field of the microscope at once. There are no spines and the ovicells are endozooecial. The mural rim is thin, but the rather heavy descending cryptocyst is granular and there may be a narrow horizontal shelf which sometimes develops minute denticles on its margin. The avicularian mandible is semicircular or somewhat triangular in form with a rounded tip; there is no pivotal bar, but well-marked hinge denticles are present. Because of the endozooecial ovicell this species cannot remain in *Crassimarginatella,* and it has the appearance of a species of *Antropora* with somewhat larger and less pointed avicularia.

Described by Hastings from Balboa, Canal Zone, from the Galapagos Islands, and also recorded from Mazatlan, Mexico, in the Busk collection.

Hancock Stations: Occurring in 47 of the Hancock dredging stations from Point Conception, California, to Peru and the Galapagos Islands, at depths from 2 to 78 fms.

Genus CAULORAMPHUS Norman, 1903

The frontal area entirely membranous, the walls comparatively thick with numerous spines; avicularia stalked, tall and slender with a narrow base, situated among the lateral spines but arising just outside of the row of spines on the lateral area of the wall. Pore chambers present. Ovicell endozooecial or wanting. Genotype, *Flustra spiniferum* Johnston.

Key to Species of *Cauloramphus*

1. Zooecia well separated by deep grooves. 2
 Zooecia closely set, interzooecial grooves inconspicuous. . *spiniferum*
2. Moderately large, walls high, spines all long and nearly erect, avicularium tall and gradually enlarged above the narrow base. *cymbaeformis*
 Smaller species, walls lower, spines more curved over the opesia, avicularium shorter and more suddenly expanded. 3
3. The two distal pairs of spines stout and erected, the others sharp-pointed and curved strongly over the opesia, usually brown in color. *brunea*
 The distal pair of spines directed forward, the others more or less curved over the opesia, all the spines slender. . . *echinus*

Cauloramphus spiniferum (Johnston), 1832

Plate 5, fig. 9

?*Membranipora variegata* Hincks, 1889:8.
Membranipora spinifera, Robertson, 1900:324; 1908:265.
Membranipora spinifera, O'Donoghue, 1923:26; 1926:39.
Cauloramphus spiniferum, Hastings, 1930:713.

It is a moderately large species, the colonies often covering several square centimeters. The zooecia are large, the opesia measuring 0.40 to 0.55 mm in length. The stalked avicularia are usually abundant, erect and at first glance may be mistaken for stout spines. The distal spines around the opercular area are more or less erect, those around the proximal half of the opesia are smaller, sharp pointed and curve over the opesia; the usual complement of spines is 4 or 6 oral and the same number of the more proximal spines.

This well-known North Atlantic species is distributed abundantly along the west coast of North America from Alaska (Robertson) to southern California, and thence more sparingly to the Galapagos (Hastings) and Chile.

In the Hancock collections it was found at 25 stations, chiefly about the Channel Islands off the coast of southern California. Also found

abundant on rocks along shore in the region of Monterey Bay and at La Jolla, California. Also, Gulf of Panama, Galtsoff collection on pearl oysters.

Cauloramphus echinus (Hincks), 1882

Plate 5, fig. 8

Membranipora echinus Hincks, 1882:250; 1884:8.
Cauloramphus echinus, O'Donoghue, 1926:39.

Resembling *C. spiniferum* (Johnston) but much smaller with shorter and more slender spines; the zooecia more separated; the avicularia are shorter, more bulbous, with shorter stalk, and the rostrum is more strongly hooked. The opesia measures 0.25 to 0.30 mm in length. The stalked avicularia are less numerous than in *spiniferum*. The full complement of spines is about 8 on each side, the terminal ones directed forward, the next two pairs more or less erected, and the remainder bending over the opesia; all of the spines are more slender than those of *spiniferum*.

Described by Hincks from the Queen Charlotte Islands and recorded by O'Donoghue from numerous localities in the Vancouver Island region, low tide to 30 fms.

The above comparison is from a specimen in the author's collection, "Virago Sound, British Columbia, Queen Charlotte Islands, 8-15 fath., G. M. Dawson," and is no doubt from the same material as Hincks' type.

Hancock Station 1281-41, east of Santa Rosa Island, California, 23 fms. Also collected at Tomales Bay, California, R. J. Menzies, collector.

Cauloramphus brunea Canu and Bassler, 1930

Plate 5, fig. 6

Cauloramphus brunea Canu and Bassler, 1930:10.

The zoaria are small, encrusting shells, pebbles and corallines. The zooecia are comparatively small, averaging 0.45 mm long by 0.35 mm wide; the separating grooves very broad so that the opesia are about as far apart as their own width. The mural rim is elevated and thick; the opesia elliptical, about 0.30 mm long by 0.15 mm wide; the descending cryptocyst granulated. A closely set row of spines surrounds the whole opesia; the distal 4 or 6 are longer and more erect, projecting somewhat forward; the remaining ones, 4 to 6 on each side, are smaller, more sharply pointed, and curve rather high over the opesia. The stalked avicularia, which are not abundant, are slender and elongate, the pedicel often longer than the expanded portion.

Canu and Bassler named this species because of the striking brown color of the spines in their specimens, but all gradations of color occur; some colonies have pale brown spines, others have the brown only at the base and others are pure white. The avicularia are always white and glistening. The species was originally described from the Galapagos Islands, Albatross Sta. D. 2815.

Hancock Stations: 137-34, Clarion Island, west of Mexico; 155-34, Albemarle Island, 167-34 and 451, Charles Island, 182-34 and 462, James Island, Galapagos; 431-35, off Octavia Rocks, Colombia; 14 to 100 fms. Also, Gulf of Panama, Galtsoff collection, on pearl oysters.

Cauloramphus cymbaeformis (Hincks), 1877

Plate 5, fig. 7

Membranipora cymbaeformis Hincks, 1877:99; 1888:217.
Membranipora cymbaeformis, Osburn, 1912:230.
Callopora cymbaeformis, Osburn, 1919:614; 1923:8D.
Cauloramphus cymbaeformis, Osburn, 1932:9.

The zoarium encrusts the stems and fronds of Bryozoa, hydroids, etc., especially on the dorsal side of *Dendrobeania murrayana* (Johnston). The zooecia are moderately large, up to 0.75 mm long, the walls high and the mural rims well separated. The gymnocyst is variable, sometimes one-third of the zooecial length but usually much shorter; cryptocyst narrow, smooth or faintly granular; 4 to 6 spines on each side, tall and slender (the distal ones may be 0.40 mm long), the proximal ones curved more or less over the opesia, the distal ones directed forward. The avicularia are tall, with a slender stalk which is graduated into the avicularian body, rising among the spines but taking their origin just outside of the row of spines.

A common species on the Atlantic coast of North America from Cape Cod, Massachusetts, to Greenland. Recorded from Icy Cape, Alaska (Osburn, Canadian Arctic Expedition).

Common at Point Barrow, Alaska, G. E. MacGinitie, collector, Alaska Research Laboratory.

Cauloramphus variegatum (Hincks), 1884

Membranipora variegata Hincks, 1884:8.

Jelly's Catalog makes this a synonym of *M. echinata* d'Orbigny, presumably with Hincks' approval. It is a *Cauloramphus* as Hincks mentions the presence of stalked avicularia. *Cauloramphus spiniferum* (Johnston) is a very common species all along the coast and frequently has the bases of the spines dark colored as in Hincks' description of *variegata*. It seems probable that *variegata* is merely a color form of *spiniferum*. The *M. echinata* (*eschinata* in the text) of d'Orbigny from Chile, is described and figured as having only three pairs of spines, all of which are on the distal half of the zooecium.

Family **Alderinidae** Canu and Bassler, 1927

In establishing this family the authors state simply, "We propose this new family for all the Membraniporae in which the ovicell is hyperstomial." This appears to be the only constant character in the midst of much diversity, but as it represents a type of reproduction different from other membranipores it is sufficiently definite.

The gymnocyst in the Alderinidae is usually small, but may cover half or more of the frontal length (*Doryporella*). The cryptocyst, in most cases, is confined to the descending portion, but it may expand to form a considerable proximal lamina. Spines are extremely varied both in number and form; occasionally they are wanting; usually they are simple in form, but they are sometimes branching and cervicorn. Avicularia are often present on the proximal gymnocyst, less frequently they occur on the lateral walls; in several genera they are interzooecial, or they may be wanting entirely.

In the following classification the genera are separated, first, on the mode of interzooecial communication, either pore chambers or rosette plates; second, on the manner of the closure of the ovicell, by the operculum or by a special membrane; third, by the nature of the avicularia, interzooecial or adventitious on the zooecial front. Some of these characters require close observation, but they appear to be the most fundamental features of the family, and the techniques are not difficult to acquire.

Key to the Genera of Alderinidae

1. Pore chambers (dietellae) present. 2
 Multiporous or uniporous septulae. No dietellae. 6
2. No avicularia, no spines. *Alderina*
 Avicularia present. 3

3. Avicularia interzooecial. 4
 Avicularia dependent, basal or lateral or both. 5
4. Avicularium associated with a kenozooecium. *Parellisina*
 Avicularium normal, interzooecial. *Copidozoum*
5. Gymnocyst small, less than one-third of the front. . . *Callopora*
 Gymnocyst extensive, one-half or more of front. . . *Doryporella*
6. Ovicell closed by the operculum. *Membraniporidra*
 Ovicell closed by a special membrane. 7
7. Avicularia and spines wanting. *Mollia*
 Avicularia and spines present. 8
8. Avicularia interzooecial, with rounded or spatulate mandible; fenestrae usually present between the zooecia. . . *Retevirgula*
 Avicularia dependent, basal or lateral or both. 9
9. Spines present, basal avicularium covers front or ovicell (except in *T. magnipora*). *Tegella*
 No spines; dorsal wall with white punctuations. . . *Bidenkapia*

Genus ALDERINA Norman, 1903

The front wall is entirely membranous, side walls crenulated; no spines, but nodular processes sometimes present; no avicularia. Dietellae present. Ovicell usually bearing a rib or depressed area. Genotype, *Membranipora imbellis* Hincks, 1880:275.

Alderina smitti new name

Plate 6, fig. 2

Membranipora irregularis, Smitt, 1873:8 (not d'Orbigny, 1839:17).
Alderina irregularis, Canu and Bassler, 1928:27.
Alderina irregularis, Hastings, 1930:708.
Alderina irregularis, Osburn, 1940:363; 1947:13.

It has been recognized for a long time (see Canu and Bassler, 1920: 142) that Smitt's *M. irregularis* is not that of d'Orbigny and a new name should be given it. It seems proper that it should be named after the great Swedish bryozoologist who described and figured it carefully.

Zoarium encrusting on stones, shells and corallines. Zooecia of moderate size, 0.45 to 0.55 mm long by about 0.35 mm wide; gymnocyst small, usually wanting, cryptocyst broad, descending, without horizontal lamina, continuing on the sides rather broadly to the operculum, the margin crenulated. The opesia is ovate and narrowed at the level of the operculum which has a brown bordering sclerite. Dietellae present. No spines, no avicularia.

The ovicell is prominent, thick walled, not closed by the operculum, 0.26 mm wide.

In the Atlantic area the species has been recorded by Smitt, Osburn, and Canu and Bassler from the Gulf of Mexico, Florida Straits, north of Cuba and the south shore of the Caribbean Sea, and Hastings recorded it from Gorgona, Colombia, in the Pacific.

Hancock Stations: 1325-41, Santa Catalina Island, California; 2167, Dewey Channel, west coast of Lower California; 591-36, Puerto Escondido, Gulf of California; 129-34, Socorro Island and 219, Clarion Island, west of Mexico; 155-34, Albemarle Island and 170-34, Chatham Island, Galapagos; shore to 60 fms. Also, Galtsoff collection, Gulf of Panama, on pearl oysters. The known distribution on the Pacific coast is from southern California to the Galapagos Islands.

Alderina brevispina (O'Donoghue), 1926

Plate 6, fig. 3

Callopora brevispina O'Donoghue, 1926:35.

Membranipora lacroixii var. *triangulata,* O'Donoghue, 1923:25, part.

This species very definitely belongs in the genus *Alderina.* It might readily be mistaken for the more southern *A. smitti* (*A. irregularis,* Smitt, non d'Orbigny) but for its much larger dimensions. It has the same zooecial and opesial form, the cryptocyst is of the same type and the operculum is a counterpart of that of *smitti* except for size. Dietellae present. A minute spine, sometimes reduced to a tiny nodule and usually entirely wanting, on each side opposite the operculum. Zooecial length 0.65 to 0.80 mm, width 0.50 to 0.60 mm.

The ovicell is more transverse than that of *smitti,* less rounded on the distal side and it is much broader, 0.40 mm.

Known only from British Columbia waters, Gabriola Pass and Banks Island. A specimen from Cadboro Bay, Victoria, British Columbia, in the writer's possession, extends the range slightly southward.

Genus MOLLIA Lamouroux, 1916

Zooecia more or less separated and connected by lateral and proximal tubes; cryptocyst extensive; operculum attached to strong condyles; short dorsal tubes for attachment to the substratum; no avicularia, no spines. Ovicell hyperstomial. Genotype, *Eschara patellaria* Moll, 1803:75.

The position of this genus in the classification has always been questionable. Lamouroux (1816:115) removed *patellaria* from the old Linnaean genus *Eschara* where Moll had described it and placed it next to *Flustra.* Heller (1867:94) redescribed it as a new species, *Diachoris simplex,* placing it in that genus because of the connecting tubules. Smitt

(1873:12) retained the genus *Mollia* and placed it next to *Membraniporella.* Waters (1897:667) discarded *Mollia* and listed *patellaria* under *Membranipora,* which appears to be the best guess to date. Canu and Bassler (1928:69), because of the appearance of the frontal associated it tentatively with the Division Coilostega, in the family Aspidostomatidae.

The simplicity of *M. patellaria,* which lacks most of the characters commonly used in classification, is responsible for most of the difficulty. However, the absence of characters which would relate this form to any of the Coilostegan species is important, for there is no polypide tube and I have been unable to find any trace of opesiular muscles or of their dorsal attachments and there are no opesiular notches or slits. Canu and Bassler recognized this difficulty in their statement "the genus could just as well be classed next to *Amphiblestrum.*" It is similar to *Retevirgula* in the tubular connections between the zooecia and in the tubular dorsal attachment processes but that genus possesses avicularia and spines.

Because of the hyperstomial ovicell, the general membraniporoid simplicity and the absence of characters which would definitely locate it elsewhere, I suggest that its proper place is somewhere in the family Alderinidae and probably near to *Alderina,* with which it agrees in the hyperstomial ovicell and the absence of avicularia and spines. It agrees with *Alderina* also in the presence of pore chambers, which appear to replace the connecting tubules when the latter are absent.

Mollia patellaria (Moll), 1803

Plate 4, figs. 8 and 9; Plate 29, fig. 6

Eschara patellaria Moll, 1803:75.
Diachoris simplex Heller, 1867:94.
Mollia patellaria, Smitt, 1873:12.
Membranipora patellaria, Waters, 1898:667.
Membranipora patellaria, Calvet, 1902:12.
Mollia patellaria, Canu and Bassler, 1928:69.

Zoarium encrusting loosely, attached by tubular dorsal processes, pale and shining. Zooecia small, averaging about 0.40 mm long by 0.26 mm wide, ovate with the distal end evenly rounded and slightly raised. The earlier zooecia near the center of the colony are more or less disjunct and connected by 6 or 8 short tubules, one at each end and 2 or 3 on each side; outside of the central area the side walls of the zooecia are in direct contact. The mural rim is moderately thick and coarsely granulated, somewhat thinner at the distal end. The cryptocyst covers about two-thirds of the frontal length, distinctly granular, its distal end more

or less transverse; the opesia is trifoliate, the operculum very small (0.08 mm wide), semicircular and attached to conspicuous cardelles. Avicularia and spines wanting.

The species is known from the Mediterranean Sea, the Gulf of Mexico and Australia.

Hancock Station 1662-48, Santa Cruz Island, southern California, 23 fms, several colonies on shells. Also one colony on a shell from San Felipe, Mexico.

Genus MEMBRANIPORIDRA Canu and Bassler, 1917

"The operculum always closes the ovicell. No dietellae. No avicularia. One large distal septula; two pairs of lateral septulae" (C. and B.). Genotype, *M. porrecta* Canu and Bassler, 1917.

The ovicell is hyperstomial but is deeply excavated in the base of the distal zooecium, seeming to extend almost to the dorsal wall. The genus appears much like *Alderina,* with which it may readily be confused, but there are no dietellae and the ovicell is closed by the operculum.

Membraniporidra porosa new species

Plate 6, fig. 1

Zoarium forming a thin incrustation on a gastropod shell.

Zooecia large, 0.75 to 0.90 mm long by 0.55 to 0.65 mm wide; very distinct, the walls sloping strongly inward and upward, and separated by a broad and deep sulcus; the mural rim and small gymnocyst smooth and shining; cryptocyst slightly granulated (scarcely evident). The mural rim is thin, without spines (one zooecium bears a pair of small tubercles opposite the distal end of the operculum; these are on the outside of the mural rim and do not rise above its level). The opesia is large, length 0.65 to 0.80 mm, width 0.45 to 0.55 mm, rather regularly elliptical in form. The frontal ectocyst is moderately thick and pale yellow in color; the operculum more heavily chitinized and with a thickened brown border, width 0.20 mm. No avicularia. No dietellae.

The ovicell is hyperstomial, closed by the operculum, prominent, subglobular, thick-walled, smooth and shining and perforated by numerous pores; width 0.30 to 0.35 mm, length 0.25 to 0.30 mm.

This species is placed in the genus *Membraniporidra* because of the absence of avicularia and spines and the presence of a hyperstomial ooecium closed by the operculum. The general appearance of the zooecia is similar to that of species of *Aplousina,* but the well-developed hyperstomial ooecium excludes it from that genus. The perforation of the

ooecium is an unusual character in Alderinidae. The genus is well represented in the American Tertiary, but no recent species has hitherto been recorded from American waters.

Type, AHF no. 17.

Type locality, Hancock Station 1914-39, off Pyramid Cove, San Clemente Island, California, 78-110 fms, encrusting a gastropod shell.

Genus CALLOPORA Gray, 1848

Genotype, *Flustra lineata* Linnaeus.

Gray's genus was neglected almost entirely for many years until reestablished by Norman (1903:588). The characters given by Norman are: front wall entirely membranous, marginal walls more or less thickened and crowned with a few or many spines. Ovicell commonly with a rib across the front. Sessile avicularia with acute mandible at the bottom of the zooecium and above the ovicell or in a lateral position on one or both sides of the oral opening, or in both positions in the same species. Usually two pairs of lateral and one distal dietellae.

Canu and Bassler (1920:146) included the *tenuirostris* group of Waters, but Harmer has established the genus *Copidozoum* for this group and his judgment is accepted here. This excludes those species in which the avicularia are large, vicarious and replace zooecia in the series. *Callopora* has been much misunderstood and many species have been listed under this genus which properly belong elsewhere.

Key to Species of *Callopora*

1. Avicularia wanting, accessory distal spines outside of the main row. *whiteavesi*
 Avicularia present 2
2. Lateral (distal) avicularia only. 3
 Proximal avicularia present. 4
3. Avicularia minute, marginal, spines long and numerous. *corniculifera*
 Avicularia somewhat larger, spines fewer and shorter. . . . *exilis*
4. Proximal avicularia only, single or paired. 5
 Both proximal and lateral avicularia present. 9
5. Avicularia large, often curved around the opesia. 6
 Avicularia smaller, mandible straight. 7
6. Zooecia well separated, with areolations between. . *circumclathrata*
 Zooecia closer together, no interzooecial areolations. . . *horrida*
7. Spines 1 to 3, ovicell with a v-shaped area. *aurita*
 Spines numerous. 8

8. Spines usually 7 on each side, distal ones erect, proximal ones directed somewhat forward, meeting over opesia. . . . *craticula*
 Spines 5 or 6 on each side, directed more laterally and not meeting over the opesia. *lineata*
9. Lateral avicularia elevated, at the side of the operculum. . *armata*
 Lateral avicularia proximal to the operculum, little elevated; ovicell very small. *inconspicua*

Callopora armata O'Donoghue, 1926

Plate 6, fig. 10

Callopora armata O'Donoghue, 1926:34.

The zoarium is moderately thin, encrusting and white. Zooecia distinct, with occasional small interzooecial fenestrae; moderate in size (0.50 to 0.60 mm long by 0.26 to 0.30 mm wide); the opesia elliptical (0.35 to 0.40 mm long by 0.30 to 0.26 mm wide), constricted rather sharply at the operculum which is 0.13 to 0.15 mm in width. The walls are moderately thick, the mural rim low and smooth; the descending cryptocyst thin but conspicuously and evenly crenate to the region of the operculum; gymnocyst occupying about one-fourth of the frontal length. Spines: a small erect one at each distal corner, along each side 4 or 5 more or less arched over the opesia, and a similar median proximal spine. Avicularia: one of moderate size on the front of the gymnocyst, often replaced by a pair of smaller ones; one on each side near the distal corners with the mandible directed forward and inward; occasionally an additional small avicularium on one or both sides at about the middle of the opesia.

Ovicell hyperstomial, somewhat immersed, the ectooecial layer not quite complete, slightly granular and without transverse rib; the avicularium distal to the ovicell is only slightly enlarged.

This description differs somewhat from that of O'Donoghue, especially in the number and arrangement of the avicularia, but as he found no ooecia he was doubtless describing a younger stage. Some doubt is therefore attached to the present identification. The species was described from a single specimen from Bull Passage, British Columbia in 30-35 fms. The general appearance of this species is similar to that of *Tegella arctica* (d'Orbigny), but it differs in the possession of pore chambers and in the nature of the ooecial cover.

Off Cadboro Bay, British Columbia, several colonies collected by G. E. MacGinitie.

Callopora aurita (Hincks), 1877

Plate 7, fig. 2

Membranipora aurita Hincks, 1877:213.
Membranipora aurita, Osburn, 1912:230; 1933:21.

Zoarium encrusting, usually on shells, forming very regular rounded colonies when not crowded. Zooecia moderate in size, ovate, considerably narrowed toward the distal end; walls high and strongly calcified; in older stages the cryptocyst forms a narrow shelf; gymnocyst occupying about one-fourth of the zooecial length. Usually with a single erect spine just proximal to the operculum on one or both sides, occasionally an additional smaller spine is present. Avicularia: when an ovicell is present there is a pair of small avicularia on the gymnocyst, directed forward and outward; in the absence of an ovicell there is a single larger avicularium with its mandible directed backward.

The ovicell is rounded, more or less immersed, with a strong raised rib which encloses a triangular area above the orifice and which may rise to form an umbo on the top.

This is a common species on both sides of the North Atlantic but its presence in the Pacific has not hitherto been noted.

Canoe Bay, Alaska, 125 fms, U. S. Alaska Crab Investigation, Sta. 24-40. Also at Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector.

Callopora circumclathrata (Hincks), 1881

Plate 8, fig. 2

Membranipora circumclathrata Hincks, 1881:131.
Membranipora circumclathrata, Robertson, 1908:259.
Membranipora circumclathrata, O'Donoghue, 1923:24.
Callopora circumclathrata, O'Donoghue, 1926:33.
Callopora circumclathrata, Canu and Bassler, 1923:43.
Retevirgula circumclathrata, Brown, 1948:110.

Zoarium encrusting on shells, stones and algae, but loosely attached. Zooecia about 0.50 mm long by 0.30 mm wide, well separated by deep grooves, or disjunct and united by short tubules with small fenestrae between them; walls moderately thick; mural rim smooth or slightly granular, the descending cryptocyst somewhat crenulate on its inner border; gymnocyst well developed, frequently covering one-third of the zooecial front; opesia oval to elliptical. Spines: one or two distal pairs more or less erect; three to five on each side, much flattened and bending strongly across the opesia, their points often touching.

A small avicularium, with some areolations about the base of the chamber, situated on the gymnocyst just proximal to the opesia, the mandible usually triangular but occasionally rounded; in the presence of an ovicell the avicularium becomes much larger, elongated and its chamber unites with the distal surface of the ectooecium.

The ovicell is prominent, rounded, the usual transverse rib present but reduced in size and there are fine longitudinal striae on the otherwise smooth surface. The ovicell, with the distal avicularium, resembles that of the *Tegella* species.

This species has recently been placed by Brown in his new genus *Retevirgula,* on the basis of disjunct zooecia with connecting tubules. That, however, appears to be the only character in common with that genus. Among the numerous colonies at my disposal I have found no zooeciules, though the avicularian chambers sometimes suggest that nature; they are very definitely frontal avicularia developed on the surface of the gymnocyst, and the tubules which appear to connect with them really are connected with the zooecium below the bases of the avicularian chambers. The ovicells of *circumclathrata* are not like those of *Retevirgula* as they lack the fenestra in the ectooecium; they have a fairly close resemblance to those of *Tegella,* but the presence of large dietellae removes them from that genus.

Hincks described the species from "Santa Cruz, California," Robertson listed it from "various localities near the coast of southern California," and O'Donoghue recorded it from numerous localities in British Columbia.

Hancock Station 1410-41, Santa Barbara Island, California, 20 fms. Numerous specimens from Del Monte, California, 25 feet, (in Miss Blagg's collection); also in shallow water at Palos Verdes, Redondo Beach and Santa Monica, California. Pleistocene of Santa Monica Canyon, California (Canu and Bassler). There is also a specimen labelled merely "off Colombia"; the datum is probably correct as all of the other species in the lot are definitely tropical.

Callopora corniculifera (Hincks), 1884

Plate 7, fig. 1

Membranipora corniculifera Hincks, 1884:11.

?*Cauloramphus triangularis* Canu and Bassler, 1923:48.

Zoarium encrusting. Zooecia moderately large, 0.60 to 0.70 mm long by 0.40 to 0.50 mm wide, distinct with broad separating grooves; gymnocyst usually small but occasionally as much as one-third of the zooecial

length; cryptocyst narrow, sharply descending, delicately crenated. Opesia oval, narrower at the distal end. Spines all tall, especially the distal ones, usually 8 or 9 on each side but often only 5 or 6; also there are 2 or 3 smaller spines distal to the oral spines, often wanting. The avicularia are minute, sessile, on the outer side of the mural rim usually a little proximal to the operculum, with a short-triangular mandible.

The ovicell is prominent, subglobose, 0.24 mm wide, and when completely calcified it has a pointed umbonate process just above the aperture. (Hincks' figure, 4a, plate 20, is misleading as the "horn-like projection from the center of the oral margin" appears to be horizontal).

Canu and Bassler were aware of the similarity to *corniculifera* in describing their *Cauloramphus triangularis* from the Pleistocene of Santa Barbara, but they could not know the range of variation in *corniculifera.* Except for the difference in size, the characters of *triangularis* fall within the range of variation in *corniculifera.* It cannot be a *Cauloramphus* on account of the hyperstomial ovicell, and the "semicircular area" is similar to that of *corniculifera* before calcification is complete.

Apparently this species has not been noted living since Hincks described it from Cumshewa, British Columbia.

Hancock Station 1171-40, Catalina Island, California, 38 fms, on brachiopod shells. Also at Tomales Bay, California, 6 fms, on a clam shell.

Callopora craticula (Alder), 1857

Plate 6, fig. 7

Membranipora craticula Alder, 1857:144.
Membranipora craticula, Hincks, 1880:147.
Callopora craticula, Osburn, 1923:8D.

Zoarium encrusting, forming a very spiny delicate layer on shells, stones, etc. Zooecia usually quite regularly disposed, 0.40 to 0.55 mm long by 0.25 to 0.30 mm wide; gymnocyst well developed; cryptocyst small; mural rim raised and narrow and beset with 7 to 9 spines on each side, the two anterior pairs long and erect, the others progressively shorter toward the proximal end and recumbent over the opesia; opesia oval, 0.25 to 0.30 mm long. There is a salient avicularium, with triangular mandible, on the gymnocyst in the midline or on either side; when an ovicell is present the avicularian chamber is usually enlarged and partially covers the distal end of the ooecium and the mandible is enlarged. The ooecium is large, hyperstomial, not closed by the operculum, smooth, with a raised rib across the middle.

It is a common species on the coasts of Europe and the Arctic seas and Osburn has recorded it from arctic America and down the east coast as far as to Cape Cod. It does not seem to have been noted on the Pacific coast, but there are specimens in the Hancock collections from Punuk Island in the Bering Sea and Cleveland Passage, Frederick Sound, Alaska. Common at Point Barrow, Alaska, G. E. MacGinitie, collector, Arctic Research Laboratory.

Callopora exilis (Hincks), 1882

Plate 6, fig. 8

Membranipora exilis Hincks, 1882:249.
Callopora exilis, O'Donoghue, 1926:33.

Zoarium encrusting, thin. Zooecia distinct, rather regularly elliptical; the opesia occupies nearly all of the front and averages 0.40 mm long by 0.26 mm wide; walls low, well calcified, the descending cryptocyst narrow and smooth on its inner border; gymnocyst often well-developed. There are two pairs of small distal erect spines, and on each side are 4 to 6 small spines which bend slightly over the opesia. Occasionally there is a small avicularium on the side of the lateral wall, just outside of the row of spines; it is so obscure that it is easily overlooked.

The ooecia are small, rounded, prominent, without a rib, and smooth or with minute striations, 0.26 mm wide by 0.20 mm long.

Hincks described the species from Houston Stewart Channel, Queen Charlotte Island and O'Donoghue recovered it from Banks Island, Victoria, British Columbia and added to Hincks' description.

Canoe Bay, Alaska, 125 fms, U. S. Alaska Crab Investigation, Sta. 24-40.

Callopora lineata (Linneaus), 1758

Plate 6, figs. 4 and 5

Membranipora lineata, Hincks, 1880:143.
Callopora lineata, Osburn, 1923:7D.
Callopora lineata, O'Donoghue, 1926:32.

Zoarium encrusting. Zooecia moderate in size, averaging about 0.60 mm long by 0.35 mm wide; gymnocyst usually well-developed, occupying about one-third of the length; cryptocyst moderate, granulated, without horizontal lamina. Opesia elliptical or a little narrowed distally; walls beset with about 7 spines on each side, the two distal ones erect, the others bending somewhat over the opesia. Avicularia elevated on the gymnocyst, usually single (sometimes a smaller pair) with triangular mandible.

Ovicell prominent, rounded, smooth with a transverse rib, width about 0.25 mm.

This species has some resemblance to *C. craticula,* but Hincks (1889: 46) has indicated the differences: *M. lineata* differs in the larger size, the less regular arrangement of the zooecia, the spines rounded and much less recumbent.

It is a common Atlantic species, on the American coast from Cape Cod to Greenland and Osburn has recorded it as far west in the Arctic Ocean as Bernard Harbor, Northwest Territory (about 115 degrees W). O'Donoghue lists it at a number of localities in British Columbia.

Hancock Station 1662-48, Santa Cruz Island, southern California. Specimens also from Dillon Beach, California, Menzies, collector, and Nunivak Island, Alaska. It does not appear to be a common species on the Pacific coast.

Callopora horrida (Hincks), 1880a

Plate 6, fig. 9

Membranipora horrida Hincks, 1880a:82; 1884:7.
Membranipora californiensis Waters, 1898:681.
Membranipora horrida, Robertson, 1908:260.
Membranipora horrida, O'Donoghue, 1923:24.
Callopora horrida, O'Donoghue, 1925:97; 1926:33.

Zoarium encrusting shells, stones, sponges, etc. Zooecia ovate, very distinct with wide grooves; opesia more or less ovate, the mural rim thick, elevated and slightly crenate. Dietellae in the lateral and distal walls. Two or three pairs of stout erect distal spines and the same number of lateral ones which are smaller, sharp-pointed and curved over the opesia. A large avicularium is located on the basal gymnocyst, its long pointed mandible, which is often curved laterally, directed forward to one side of the opesia; occasionally smaller avicularia of similar form are present in the same position.

Ooecium rather small, globular, with a transverse rib near its aperture; the avicularium of the distal zooecium is often attached partly to the ooecium, but does not cover it as in the genus *Tegella.*

There is much variation in the number and size of the spines and in the width of the separating grooves.

Hincks described this species from California, as did Waters his *californiensis.* Robertson listed it from Puget Sound southward to Pacific Grove, California. O'Donoghue recorded it from numerous localities, Puget Sound northward in British Columbia.

Hancock Stations: 147-34, Tagus Cove, Albemarle Island, Galapagos, 30 fms; 788-38, Daphne Major Island, Galapagos, 70 to 80 fms; 1232-41, off San Pedro breakwater, California, 19 fms; 1410-41, Santa Rosa Island, California, 17 fms; and 275, Raza Isla, Gulf of California, 40 fms. Apparently it is much more abundant in its northern range.

Callopora whiteavesi Norman, 1903

Plate 6, fig. 6

Callopora whiteavesi Norman, 1903:589.
Membranipora lineata, Smitt, 1867 (in part, Pl. 20, fig. 26).
Membranipora whiteavesi, Levinsen, 1916:443.
Callopora whiteavesi, Osburn 1932:8.

Zoarium encrusting. Zooecia of moderate size, 0.50 to 0.60 mm long by 0.35 to 0.40 mm wide, the oval to elliptical opesia occupying about three-fourths of the length. The zooecia are well separated by rather broad grooves; the cryptocyst granulated and without horizontal lamina, the gymnocyst smooth. The spines, 8 to 11 on each side, are long and more or less erect, the distal ones directed forward; a few smaller terminal spines are sometimes present beyond the distal rim. Avicularia apparently are entirely wanting.

The ovicells are globose, prominent, smooth or delicately frosted with minute tubercles; in complete calcification there may be a slightly raised rib enclosing a triangular area on the front.

Described by Norman from East Finmark, Norway; since recorded by Levinsen from Greenland, and by Osburn from Ungava, Hudson Strait, and Port Churchill, Manitoba. The present records indicate that it probably has a circumpolar distribution.

Canoe Bay, Alaska, along shore, (U. S. Alaska Crab Investigation); Point Barrow, Alaska, 12 fms, G. E. MacGinitie, Arctic Research Laboratory.

Callopora inconspicua (O'Donoghue), 1923

Membranipora inconspicua O'Donoghue, 1923:29.

The small zooecia are oval, tending toward polygonal. The edges are covered by a thin, almost transparent, white lamella, which passes upward to a fairly regular oval aperture. The opesia has a sort of curved border around it, wider at the posterior end. Commonly two small avicularia are borne on this border, one on each side about one-third of the way from the distal end; their rounded mandibles face upward and

slightly inward and forward; sometimes, when an ooecium is present, a third slightly larger avicularium is produced at the end of this, its mandible facing upward and forward. Spines, 3 pairs of distal ones, long and erect, and back of these about 5 pairs of small pointed spines directed inward over the aperture. Ooecium small, but prominent, smooth, subglobular. (After O'Donoghue).

This species cannot remain in *Membranipora,* as that genus is now understood and, while its author did not discuss all the characters of generic importance, it appears to be best allocated to *Callopora.* Described from Northwest Bay and off Snake Island, British Columbia.

Callopora (?) verrucosa Canu and Bassler, 1930

This is a very unusual species which has not appeared in the Hancock collections. Canu and Bassler (1930:9) state that "The ovicell is hyperstomial, globular," which would indicate the genus *Callopora.* On the other hand, there are small interzooecial avicularia in the corners between the zooecia and some of these are vestigial, while around the zoarial border there is a band of similar heterozooecia, many of which bear avicularia with a short triangular mandible. The nature of the interzooecial avicularia and their vestigial counterparts suggests the genus *Antropora,* but the hyperstomial ovicell prevents inclusion in that genus. It was described from the Galapagos Islands, Albatross station D.2813.

Genus COPIDOZOUM Harmer, 1926

"Zooecia with greatly reduced gymnocyst, the membrane covering almost the entire frontal surface. Cryptocyst most developed proximally, moderate to extensive. Spines present, absent or vestigial. Avicularia vicarious, numerous, alternating with the zooecia, the rostrum triangular proximally, usually narrow and linear distally, the mandible of corresponding form. Ovicells hyperstomial." (Harmer, 1926:226). Genotype, *Membranipora plana* Hincks.

Key to Species *Copidozoum*

1. Spines wanting. 2
 Spines present. 3
2. Zooecia large, cryptocyst moderately developed, opesia elliptical. *planum*
 Zooecia moderate size, cryptocyst thick and coarsely granulated, opesia oval. *tenuirostre*
3. Spines all simple. *spinatum*
 Distal spines forked or alcicorn. *protectum*

Copidozoum tenuirostre (Hincks), 1880a

Plate 7, fig. 4

Membranipora tenuirostris Hincks, 1880a:70; 1884:7.
Callopora tenuirostris, O'Donoghue, 1926:33.
Callopora tenuirostris, Canu and Bassler, 1929:8.
Copidozoum tenuirostre, Marcus, 1937:48.

Zoarium encrusting. Zooecia of moderate size, usually between 0.45 and 0.55 mm in length, and 0.30 to 0.40 mm wide. Distinct, the walls thick and the descending cryptocyst heavy and coarsely granulated, without a horizontal lamina; gymnocyst little developed. Opesia ovate, usually distinctly narrowed at the operculum. Dietellae are usually present, one in the distal and one or two in the lateral wall, but the pore chambers may be absent leaving only large multiporous rosette plates, which appears to agree with the observations of Waters (1898:685) on Mediterranean specimens. The avicularia are interzooecial, occupying the place of zooecia; the chamber usually diamond-shaped; the rostrum long, elevated toward the tip and with a narrow groove; the mandible is elongated, almost filiform, with a triangular base attached to a pair of strong denticles. Spines wanting.

The ovicell is prominent, globose, minutely porous and decorated with minute knobs or merely granulated; not closed by the operculum.

The original description by Hincks (1880:70) states that there is "an acuminate spine at the bottom of the aperture bending inward, and usually two or three on each side." Spines are entirely wanting on all of the Pacific coast specimens; Waters (1898:685) found no lateral spines, except occasionally a small one proximal to the ovicell in Mediterranean material; and Marcus (1937:49) found no spines on specimens from Brazil, though they were present, as Hincks illustrated them, in specimens from St. Helena Island (1939:201).

Distributed around the world in tropical and temperate waters. Hincks and O'Donoghue recorded it from several localities in British Columbia and Canu and Bassler from the Galapagos Islands.

In the Hancock collections it occurred at 56 stations, distributed from northern California to Peru and the Galapagos Islands, and from low tide to 70 fms.

Copidozoum planum (Hincks), 1880

Membranipora plana Hincks, 1880a:81.
Copidozoum planum, Hastings, 1930:713.

"Zooecia large, oval, distinct, surrounded by a narrow border, which is rounded and finely crenate, sometimes slightly produced below the aperture and pointed; front wall wholly membranous, very much on a level with the margin of the cell, so as to give a flattened appearance to the surface of the zoarium. Avicularia scattered, placed in somewhat lozenge-shaped intercellular spaces; beak elongate, straight, occupying the center of the area, traversed by a narrow groove which expands toward the lower extremity; mandible with an enlarged base, above it setiform, slightly curved at the top. Ooecium rounded, rather large, frosted." (Hincks 1880a:81).

The species was described from Australia and has since been recorded from the Mediterranean (Canu and Bassler 1928:32); from Japan (*Membranipora vibraculoides* Okada, 1923:223), and Hastings has listed it from Coiba, Panama; Gorgonia, Colombia; the Galapagos Islands, and also mentions specimens from California in the British Museum. In all the numerous specimens I have examined from all along the coast from California to the Galapagos Islands there are none that I can positively separate from *tenuirostre* except on the basis of the lack of spines. I have found occasional specimens with thinner walls, but these were not larger than *tenuirostre.* This raises the question whether only those with heavy spines, as shown by Hincks (1880, plate 9, fig. 3) and Marcus (1937, text fig. 7) should be included in *tenuirostre* and those without spines under *planum,* regardless of the width of the cryptocyst. On this basis all of the Pacific coast specimens belong under *planum.*

Copidozoum protectum (Hincks), 1884

Plate 7, fig. 5

Membranipora protectum Hincks, 1884:10.
Membranipora protectum, O'Donoghue, 1923:25.
Amphiblestrum protectum, O'Donoghue, 1926:38.

Zoarium encrusting. Zooecia very distinct, moderate in size, 0.40 to 0.50 mm long by 0.25 to 0.30 mm wide. Gymnocyst and cryptocyst both small and the opesia occupies nearly all of the frontal area. The mural rim is thin and high, the descending cryptocyst narrow, without horizontal shelf, granulated. Spines: one erect, simple or slightly bifid, at each distal corner; one on each side of the operculum, also erect and

bifid; one more proximally on each side, alcicorn with 3 to 6 points, recumbent over the opesia; in advanced stages the points may fuse, as stated by O'Donoghue. The avicularia are interzooecial, with a very elongate narrow rostum, and the mandible is similarly long (as much as 0.40 mm) and attenuated or filiform. Dietellae present.

Ovicell rather large, averaging 0.20 mm wide, prominent, the surface delicately granulated.

O'Donoghue placed this species "provisionally" under *Amphiblestrum,* but the opesia occupies all of the frontal area; there is no horizontal cryptocyst, and the avicularia are vicarious.

Described by Hincks from British Columbia and recorded by O'Donoghue from numerous localities from Victoria and the San Juan Islands northward.

Hancock Stations: Distributed along the whole western coast of the United States and south along the peninsula of Lower California, and in the Gulf of California.

Copidozoum spinatum new species

Plate 7, fig. 3

The only colony completely encrusts a rounded object. The zooecia are of moderate size, 0.45 to 0.55 mm long by 0.26 to 0.30 mm wide; distinct and the mural rims never in contact; opesia elliptical; mural rim thin and the cryptocyst very narrow and scarcely granulated. The rim is beset with numerous spines of equal size, 5 to 7 on each side. The interzooecial avicularia are small, the rostrum short (0.13 mm), but otherwise similar to those of *tenuirostre.* Multiporous septulae.

Ovicell globular and very prominent, about 0.18 mm wide; perforated with minute pores and delicately granulated. The pores are definitely larger than in *tenuirostre* where they are usually visible only by transmitted light in balsam mounts.

The zooecia have much the appearance of *C. (Membranipora) planum,* as shown in Hincks' plate 11, fig. 2 (1880), but they are much smaller and the array of marginal spines is an important difference. Apparently all of the spines are simple and of about the same size, judging by the bases; the specimen was dead and only the bases of the spines remain.

Type, AHF no. 18.

Type locality, Hancock Station 339, Gulf of Dulce, Costa Rica, 8°24′20″N, 83°13′40″W, 48 fms. One colony.

Genus **PARELLISINA** Osburn, 1940

This genus was erected by Osburn (1940:360) to include those species, formerly listed under *Membranipora* and *Callopora,* in which the avicularium is always associated with a heterozooecium or kenozooecium. The avicularian chamber is proximal to that of the kenozooecium and separated from it by a vertical wall. Besides the genotype, *Membranipora curvirostris* Hincks, the following species seem to belong here: *M. falcata* MacGillivray, *M. albida* Hincks, *Callopora tenuissima* Canu and Bassler, *C. subalbida* Canu and Bassler, *P. latirostris* Osburn and *Ellisina latirostris* Silen (not Osburn).

Parellisina curvirostris (Hincks), 1862

Plate 8, fig. 8

Membranipora curvirostris Hincks, 1862.
Ellisina curvirostris, Harmer, 1926:228.
Callopora curvirostris, Canu and Bassler, 1928:32.
Ellisina curvirostris, Hastings, 1930:711.
Parellisina curvirostris, Osburn, 1940:361.

Zoarium encrusting. Zooecia separated by grooves, gymnocyst small or wanting; mural rim thin, little raised; a vestigial spine on either side of the aperture, often wanting, and occasionally others on the lateral walls; a narrow granulated cryptocyst. Ovicell hyperstomial, small but prominent, globose, the frontal surface delicately granulated. The avicularium is interzooecial, large and more or less curved sideways; followed in series by a kenozooecium which varies considerably in size and form and which is covered by a membrane; its opesium is usually more or less triangular and a delicate mural rim may be present. Hastings recorded the species from the Galapagos Islands. Otherwise it is known around the world in warmer seas.

Hancock Stations: 142-34, Clipperton Island, west of Mexico, and 147-34, 155-34, 198-34 and 362-35, all from the Galapagos Islands. Also in the Galtsoff collection on pearl oyster shells from the Gulf of Panama.

Genus **BIDENKAPIA** new genus

Zoarium encrusting and loosely attached or rising in flabellate expansions or contorted frills. Zooecia large, walls very high and thin with multiporous rosette plates; dorsal wall smooth with numerous white punctations; gymnocyst and cryptocyst well developed; no spines; usually a single large avicularium covers the whole breadth of the gymno-

cyst, but occasionally this may be replaced by a pair of smaller ones in the proximal corners. Ooecium prominent, hemispherical, smooth, hyperstomial and not closed by the operculum. In the presence of the ovicell, the larger avicularium appears to be always absent, but when the smaller avicularia are present one of these is usually located at one side distally and its chamber is not involved in the ooecial cover. Genotype, *Membranipora spitsbergensis* Bidenkap, 1897.

While definitely a member of the family Alderinidae, the combination of characters presented by *M. spitsbergensis* will not permit its inclusion in any known genus.

Bidenkapia spitsbergensis (Bidenkap), 1897

Plate 8, fig. 6

Membranipora spitsbergensis Bidenkap, 1897:619.
Membranipora spitsbergensis, Nordgaard, 1900:9.
Membranipora spitsbergensis, Kluge, 1906:38.
Callopora spitsbergensis, Nordgaard, 1918:44.
Callopora spitsbergensis, Osburn, 1919:609; 1923:8D; 1932:8.

The zoarium is encrusting but loosely attached or rising in bilaminate or unilaminate frills or flabellate expansions, rough, conspicuous and yellow to orange in color when fresh.

The zooecia vary much in dimensions but are usually large, averaging about 0.80 mm long by 0.45 mm wide, occasionally more than 1. mm in length, and the zooecia are unusually deep. The walls are all comparatively thin, the mural rim thin and smooth or granulated, the dorsal wall thin, smooth, shining and thickly punctate with white dots. In the absence of ovicells and avicularia the gymnocyst is usually little developed; the cryptocyst varies greatly, sometimes filling a third of the proximal end of the opesia and again it is scarcely noticeable. Large multiporous septulae are present, about a third of the distance above the dorsal wall. Spines are entirely wanting.

Two sizes of avicularia are known. Usually a large one occupies the whole width of the proximal end of the zooecium, the short rostrum elevated and the bluntly triangular mandible directed backward or laterally; frequently this type is wanting and they are never present when an ovicell is developed on the preceding zooecium. Instead of the single large avicularium there is sometimes a pair of smaller ones, one in each proximal corner, and one of these is rarely present at the distolateral side of the ovicell. There is some intergradation between the two types of avicularia, single median ones occasionally present among the smaller avicu-

laria, and small lateral ones rarely on colonies with the large median type, but as a rule only one type of avicularium is present in any one colony.

The ovicell is prominent, hemispherical, about 0.40 mm wide, hyperstomial, the aperture wide and covered by a special membrane; the ectooecial wall smooth and shining, with a slightly elevated collar around the ooecial aperture when complete.

Originally known from Spitsbergen, its range has been extended (Osburn 1919, 1923) to west Greenland and Hudson Strait, and from Icy Cape, Alaska.

Punuk Island, Bering Sea, 15 fms on shells. Prof. G. E. MacGinitie has recently collected it also at Point Barrow, Alaska, 18 to 25 fms, common.

Bidenkapia spitsbergensis var. **alaskensis** new variety

Plate 8, fig. 7

This variety, partially discussed above, occurs with the typical variety, along the coast of northwestern Alaska. Since some colonies present only the smaller avicularia, it seems advisable to give it a varietal name. The difference was first noted by Osburn (1923:8D), in a specimen from Icy Cape, Alaska (Canadian Arctic Expedition Sta. 23). "In this one small specimen the zooecia are smaller, the avicularia are smaller, and there are sometimes two of them at the distal corners of the zooecium and faced toward each other. The ooecium and the zooecial characters are similar to those of *spitsbergensis* and the dorsal wall is similarly perforated."

Type, AHF no. 19.

A number of colonies, with those of the typical form at Point Barrow, Alaska, 23 fms, G. E. MacGinitie, Arctic Research Laboratory.

Genus **TEGELLA** Levinsen, 1909

"The zooecia, which have spines and a slightly developed cryptocyst, are provided with multiporous rosette plates. Hyperstomial ooecia with an incompletely calcified ectooecium, which are again surrounded by an avicularium." (Levinsen). The most important generic character is the absence of pore chambers, which separates the species of this genus from *Callopora*.

Levinsen's statement concerning the ovicell is not quite clear; the ectooecium usually does not fully cover the entooecium, but it is usually heavily calcified; the avicularian chamber may cover the distal end of

the ooecium and be so completely fused with it as to appear as one structure, or it may be partially separated by a groove. The gymnocyst is well developed and bears a large avicularium; small lateral avicularia on the mural rim are also present in some of the species. *Flustra unicornis* Fleming is the genotype.

Differentiation of the species depends chiefly on the arrangement of the spines and avicularia, which are often of uncertain value but which appear to be fairly constant in this genus. This is especially true of the avicularia; lateral avicularia present or wanting; if present they may be directed forward or backward in different species. The spines are not so constant but erect tubular spines may be present or absent; other spines may curve closely over the opesia as in *arctica,* or stand more or less erect, and there is considerable variation in the number present. In the ovicell the transverse rib which is the proximal end of the ectooecium varies so much with calcification that its importance is doubtful, but it serves to differentiate certain species from others which lack the strong rib.

Key to the Species of *Tegella*

1. Small lateral avicularia opposite the operculum. 2
 No lateral avicularia. 3
2. A strong, erect, tubular spine, usually on one side only; one or more pointed, curved spines, often wanting. *armifera*
 No erect tubular spines; 2 to 4 flattened, pointed spines on each side bent low over the opesia. *arctica*
3. Avicularia wanting; ovicell with a large fenestra or uncalcified area at the top. *magnipora*
 Pointed avicularia on the basal gymnocyst, more or less covering the ovicell when this is present. 4
4. No erect tubular spines; 1 to 3 curved spines bending over the opesia, often wanting; ovicell prominent. . . . *aquilirostris*
 An erect tubular spine present on one or both sides. 5
5. Ovicell small, deeply immersed, avicularia large. . . *robertsonae*
 Ovicell larger and prominent, avicularia smaller. . . . *unicornis*

Tegella unicornis (Fleming), 1828

Plate 9, fig. 2

Flustra unicornis Fleming, 1828:536.

Membranipora unicornis, Hincks, 1884:7.

Tegella unicornis, Osburn, 1923: 8D.

Zoarium encrusting. Zooecia moderately large, the opesia large and oval, slightly narrowed at the distal end; rim broad and finely crenulate, especially on its inner side; usually bearing 4 spines at the distal end, the more anterior pair small, erect and often wanting, the other pair larger,

erect, one usually larger than the other. An avicularium on the proximal gymnocyst, mounted on a raised projection; when an ovicell is present the avicularium appears to arise from the ovicell.

The ovicell is prominent, smooth with a transverse rib and the distal avicularian chamber forms a part of the cover.

In many respects this species is so similar to *T. armifera* (Hincks) that the latter was described as a variety. However, the distolateral paired avicularia of *armifera* are never present in *unicornis* and there are other slight differences.

Hincks listed the species from Houston-Stewart Channel, British Columbia. A common species in the northern Atlantic; on the North American side from Greenland south to Cape Cod, Massachusetts; in the Arctic west to the Northwest Territory, Canada.

Hancock Stations: 1234, Santa Rosa Island, and 1245, Santa Cruz Island, southern California; southern Alaska; Point Barrow, Alaska, G. E. MacGinitie, collector, Arctic Research Laboratory.

Tegella armifera (Hincks), 1880

Plate 9, figs. 1 and 7

Membranipora armifera Hincks, 1880a:82.
Membranipora sophiae var. *armifera,* Waters, 1889:680.
Callopora unicornis var. *armifera,* Norman, 1903:27.
Membranipora cassidata O'Donoghue, 1923:27.
Tegella cassidata, O'Donoghue, 1926:36.
Tegella unicornis var. *armifera,* Osburn, 1933:24.

This species is very similar to *unicornis* Johnston, except for the presence of the lateral avicularia. This difference is so constant that I believe *armifera* should be given specific standing. There is one other character that may be of some importance and that is the occasional presence of a curved, pointed spine which bends somewhat over the opesia and which I have never observed in *unicornis;* also *armifera* is considerably larger.

The zoarium encrusts shells, stones, algae and occasionally even small stems. The zooecia are rather large and have a wide range in measurement, length 0.60 to 0.80 mm, width 0.35 to 0.50 mm, and occasionally transcending these measurements in either direction; shorter zooecia are usually correspondingly wider, the ovate opesia varying with the form of the zooecium. The basal gymnocyst is well developed and bears an avicularium; the descending cryptocyst is somewhat thick and granulated. The spines are as follows: a small erect spine at or near each distal corner, frequently wanting; a tall stout spine on either side near the attachment

of the operculum, one of these often smaller or wanting; a pointed spine curving somewhat over the opesia at about its middle, very inconstant, usually some on the zoarium but occasionally wanting entirely. Lateral avicularia are present on one or both sides, mounted on an elevated base close to and distal to the stout spine, often wanting on one side; the triangular mandible directed proximally and somewhat vertically and outward.

The ovicell is large and prominent; the ectooecial layer forming a ridge across the middle, varying greatly in the amount of calcification and in the form and amount of curvature. The median avicularium is greatly increased in size, with a long-triangular mandible which is turned somewhat sideways; the avicularian chamber united with the ectooecial layer to a greater or less extent, sometimes surmounting the ovicell and seeming to arise from it.

I am unable to distinguish *cassidata* O'Donoghue from *armifera* by any constant character after direct comparison with colonies of the latter from the Atlantic coast. O'Donoghue says of the lateral avicularia, "the mandible lies almost vertically and is directed anteriorly and slightly inward," which must be a *lapsus calami* as his figure (pl. 2, fig. 15) clearly shows it directed proximally and outward. There is considerable variation in size and elevation and in the erection of the mandible, but in all cases they are turned backward and outward as in *armifera.*

Hincks described *M. armifera* from the Gulf of St. Lawrence; and Osburn listed it under *M. arctica* from Cape Cod, Massachusetts, and it has been reported from the arctic seas of Europe and America. O'Donoghue listed *cassidata* from numerous localities in British Columbia, "a fairly common species and a very characteristic one."

Hancock Station 1245, Gull Island off Santa Cruz, California; off San Pedro, California; Nash Harbor, Nunivak Island, Alaska, and Punuk Island, Bering Sea. Also common at Point Barrow, Alaska, G. E. MacGinitie, collector, Arctic Research Laboratory.

Tegella magnipora new species

Plate 9, figs. 3 and 4

Zoarium encrusting, reddish brown in color. Zooecia moderately large, varying in length from 0.65 to 0.90 mm and in width from 0.35 to 0.45 mm; mural rim thin and smooth or slightly granulated; gymnocyst moderately developed, sometimes almost wanting; descending cryptocyst granulated, narrow, occasionally a little expanded laterally at the proximal corners. The opesia occupy nearly all of the frontal area, ellipti-

cal or oval in form. The frontal membrane is thick and brownish, the operculum heavily chitinized and 0.20 mm or more in breadth.

The usual complement of spines is 4 on each side, very evenly spaced, stout and erect or nearly so; the second pair, opposite the operculum, are somewhat taller and much stouter than the others. No avicularia are to be found on the several colonies studied.

The ovicell is of striking appearance, even for a *Tegella*: very prominent, somewhat transverse (0.30 mm wide by 0.25 mm long), thick and heavily calcified, with a thick, elevated rim on the top surrounding a large, irregularly rounded area which is covered by a membrane, and frequently the distal side of the rim rises into a point. The endooecium is smooth, thin and only slightly calcified and is not perforated, and it is not fused with the outer layer. The ectooecium is very irregular in complete calcification and the area varies in form from perfectly circular to transversely or longitudinally elliptical, or it may be more or less irregularly rounded. On the distal aspect of the ooecium there is another rounded fenestra in the position usually occupied by an avicularium in this genus, but it is covered by a smooth membrane.

There are large multiporous rosette plates in the lateral and distal walls.

By the definition of the genus *Tegella,* the ovicell is surrounded by an avicularium. In the present species there is no evidence of an avicularian mandible, but the distal fenestra referred to may possibly be interpreted as the vestige of an avicularium. In other characters the species appears to agree in all respects.

Type, AHF no. 20.

Type locality, Canoe Bay, Alaska, 125 fms on dead shells, several colonies. Also at Point Barrow, Alaska, Arctic Research Laboratory, G. E. MacGinitie, collector.

Tegella robertsonae O'Donoghue, 1926

Plate 9, fig. 5

Membranipora unicornis, Robertson, 1900:324.

Membranipora occultata Robertson, 1908:262 (not *M. occultata* Waters).

Membranipora occultata, O'Donoghue, 1923:25.

Tegella robertsoni O'Donoghue, 1926:36.

Zoarium encrusting shells, sponges and larger algae. Zooecia moderate in size, 0.55 to 0.65 mm long, distinct only in young stages. Gymnocyst well developed, usually about one-third of the frontal length; crypto-

cyst granulated, without horizontal lamina; walls high, the rim thin when young. Opesia elliptical or oval. There is an erect hollow spine on one side at the base of the operculum and frequently a smaller one on the opposite side; proximal to these on the sides are frequently 1 to 3 smaller curved spines bending somewhat over the opesia. An avicularium is usually present on every zooecium, large, about half the zooecial length, the mandible elongate triangular, its tip slightly rounded and strongly decurved, pointing forward and to one side of the opesia.

The primary ovicell is small; the ectooecium forms a complete cover separated from the endooecium. The wall of the distal avicularium usually fuses completely with the ectooecium.

Miss Robertson first listed the species from Alaska and Queen Charlotte Islands as *M. unicornis* and later described it as *M. occultata,* overlooking the fact that Waters had previously applied that name to another species. O'Donoghue listed it for a number of British Columbia localities, and Sakakura (1935:8) recorded it from Japan.

Hancock Station 1662-48, Santa Barbara Island, California. Also from Monterey Bay, (Robertson), Dillon Beach, (Menzies), California, and Clayoquot Sound, British Columbia (E. F. Ricketts). The known range is from southern Alaska to southern California.

Tegella arctica (d'Orbigny), 1851

Plate 9, fig. 6

Membranipora conferta Hincks, 1882:249.
Membranipora sophiae form *matura,* Hincks, 1884:9.
Callopora arctica, Osburn, 1919:608.

Zoarium encrusting on rocks and shells. Zooecia of moderate size, about 0.60 mm long; the opesia elliptical or ovate, averaging about 0.40 mm long; gymnocyst well developed; descending cryptocyst narrow and granulated; the mural rim bears on each side 2 to 4 stout flattened spines which bend down closely over the opesia, the pointed tips sometimes overlapping; the absence of erect hollow spines distinguishes this species readily from others of the genus in this region, though a minute vestigial spine may occur at the base of the lateral avicularium. The mural rim also bears on each side a small elevated avicularium with a triangular mandible which is directed distally and somewhat toward the midline. A larger avicularium may be present in the usual position on the gymnocyst, but is never so much enlarged as in the other species, nor does the chamber cover the ovicell to such an extent; often they are wanting over most of the zoarium.

The ovicell is broad, not prominent, and the proximal edge of the ectooecium forms a slightly arcuate ridge across the middle. In advanced stages of calcification the ovicell tends to become immersed.

Hincks recorded this species from Houston-Stewart Channel, British Columbia. It is known from the northern coasts of Europe and ranges down the east coast of North America from Greenland to Cape Cod, Massachusetts.

Punuk Island, Bering Sea, and Cleveland Passage, Frederick Sound, Alaska. Also common at Point Barrow, Alaska, G. E. MacGinitie, collector, Arctic Research Laboratory.

Tegella aquilirostris (O'Donoghue), 1923

Membranipora aquilirostris O'Donoghue, 1926:28.
Tegella aquilirostris, O'Donoghue, 1926:37.

Zoarium encrusting on stones, shells or kelp. Zooecia of moderate size, opesia large, oval, walls raised, smooth; gymnocyst well developed; no erect spines, one to three pointed spines curving over the opesia. Ovicell prominent, with a strong transverse frontal ridge. The basal avicularium is large and when an ovicell is present the chamber becomes more or less united with the ectooecium. (After O'Donoghue.)

This species appears to be rather closely related to *robertsonae* but the prominent ovicell and the absence of erect tubular spines seem sufficient to differentiate it. Possibly it may vary into *robertsonae.* O'Donoghue found it at several localities in British Columbia waters. It has not been noted in the Hancock collection.

Genus **DORYPORELLA** Norman, 1903

This is a peculiar genus among the Alderinidae, as the reticulated gymnocyst is so extensive that it often limits the opesium so much that older authors placed the one species then known, *spathulifera* Smitt, under genera of Ascophora. Pore chambers are present; small frontal avicularia; four to six distal spines. Ovicell hyperstomial, not closed by the operculum. Levinsen (1909:150) submerged this genus in *Callopora* but as the genera in the Alderinidae are now understood *Doryporella* appears to have a satisfactory basis. Genotype, *Lepralia spathulifera* Smitt, 1867:20.

Doryporella spathulifera (Smitt), 1867

Plate 8, figs. 4 and 5

Lepralia spathulifera Smitt, 1867:20.
Microporella spathulifera, Waters, 1900:87.
Doryporella spathulifera, Norman, 1903;106.
Membranipora spathulifera, Levinsen, 1916:441.
Callopora spathulifera, Osburn, 1919:608.

Zoarium encrusting, especially on shells. The zooecia present a very unusual appearance for an anascan form. The gymnocyst extends over most of the frontal surface, occupying half or more of the proximal end and extending widely forward on either side of the aperture, the surface reticulated. The opesia is quite variable in form, usually shaped somewhat like a horseshoe, but may be a regular ellipse. The gymnocyst and ovicell are granulated. A broad, lanceolate spine, jointed at the base, arises on the median line near the proximal border of the opesia, and just behind this is a small oval avicularium, also in the midline. There are 4 to 6 oral spines, the lateral ones sometimes enlarged at the base. At either side of the operculum is a small oval avicularium. The ovicell is hemispherical, hyperstomial but not prominent. Well distributed in high northern waters.

In the Hancock collections there is a specimen from Cleveland Passage, Frederick Sound, Alaska, 12 fms. Also common at Point Barrow, Alaska, G. E. MacGinitie, collector, Arctic Research Laboratory.

Doryporella alcicornis (O'Donoghue), 1923

Plate 8, fig. 3

Membranipora alcicornis O'Donoghue, 1923:26.
Amphiblestrum alcicorne, O'Donoghue, 1926:38.

Zoarium encrusting on shells and pebbles. The zooecia are distinct with well-marked separating grooves, averaging about 0.45 mm in length by 0.30 mm in width. The proximal half of the zooecium is covered by a strongly reticulated gymnocyst which extends along the sides of the opesia, as in *D. spathulifera.* The opesia is rather regularly oval, ranging in length from 0.18 to 0.22 mm and in width from 0.16 to 0.18 mm, its rim thin and slightly raised. The cryptocyst is vestigial. At each distal "corner" is an erect, simple or bifurcate spine; on either side of the operculum another erect spine with 2 to 4 points, and toward the proximal end of the opesia there is another spine with 4 to 6 points which bends over the opesia. The avicularia are small, salient, with short-triangular mandible, situated on the gymnocyst at one side of the median

line, and resembling those of *D. spathulifera* except that they are more elevated. The ovicell is prominent, globular, 0.18 to 0.20 mm in breadth, and its surface is reticulated like the gymnocyst. Pore chambers are present, as in *D. spathulifera.*

O'Donoghue described the species in the genus *Membranipora* and later removed it to *Amphiblestrum.* It cannot, however, be associated with that genus as the calcified frontal enclosure is a gymnocyst and there is no evidence of an expanded cryptocyst. Aside from the spines its essential characters are those of *D. spathulifera.*

It was recorded by O'Donoghue from numerous localities in British Columbia, from Victoria northward.

A specimen in the Hancock collections is from Cadboro Bay, Victoria, British Columbia.

Genus **RETEVIRGULA** Brown, 1948

Retevirgula Brown, 1948:109.

This genus has been recently established to include those membraniporine species which are similar to *Callopora,* but in which the zooecia are more or less dissociated and united by tubular connecting processes; which have mural spines; rounded vicarious avicularia on zooeciules occupying a place in the zooecial series; a hyperstomial ovicell with a frontal fenestra, and which are without dietellae. The genotype is *Membranipora acuta* Hincks, 1885:249.

The species have hitherto been distributed by various authors in *Membranipora, Beana, Pyrulella, Mystriopora* (?), *Hincksina* and *Cauloramphus.* The genus seems to have a closer relation to *Pyrulella* than to any other but the species of that genus have frontal avicularia and are without connecting tubules.

Key to Species of *Retevirgula*

1. Zooecia large and broad, opesia oval, interzooecial fenestrae and zooeciules rather rare. *lata*
 Zooecia smaller and narrower, opesia elliptical, fenestrae and zooeciules frequent. 2
2. Zooecia always disjunct and connected by tubules, with conspicuous fenestrae; the proximal 4 pairs of spines curved over the opesia. *tubulata*
 Zooecia disjunct or in contact; proximal spines long, not curved, but lean somewhat over the opesia. *areolata*

Retevirgula tubulata (Hastings), 1930

Plate 8, fig. 1

Pyrulella tubulata Hastings, 1930:709.
Pyrulella tubulata, Osburn, 1940:14.
Retevirgula tubulata, Brown, 1948:110.

The zoarium is thin and unilaminar, encrusting, but loosely attached by dorsal tubular processes. The zooecia are of moderate size with a considerable range, 0.45 to 0.60 mm long. In some zooecia there is a well developed smooth gymnocyst; in others this is almost wanting. The zooecia are disjunct and connected by tubes, but here there is also much variation and frequently the neighboring zooecia are in contact. Large fenestrae between the zooecia are common, but they are often small or wanting. The avicularia are vicarious on zooeciules which are connected to zooecia or to each other by tubules; mandible semicircular. The spines are usually 6 on each side, the distal pair directed forward, the following one or two erect and the rest bending over the opesia.

The ovicell is about 0.18 mm wide, prominent, globular, with an upturned lip, and there is a large rounded fenestra situated somewhat distally on the top.

Dr. Hastings described the species from the Galapagos Islands and recorded it also from Gorgona, Colombia. Our specimens agree closely with her description.

Hancock Stations: 59-33, Charles Island, 310-35, Bindloe Island, 352-35, Chatham Island and 432, Albemarle Island, Galapagos; 225-34, Gorgona, Colombia; 457-35; Secas Islands, Panama; 132-34, Socorro Island and 223, Clarion Island, west of Mexico; 125-33, Isabel Island, Mexico; 263 and 270, Angel de la Guardia Island, Gulf of California (the most northerly record); shallow water to 80 fms. Also Gulf of Panama, Galtsoff collection on pearl oysters.

Retevirgula lata new species

Plate 7, fig. 7

Zoarium thin, unilaminar, encrusting but very loosely attached, the dorsal surfaces of the zooecia bearing short attachment processes. Zooeciules of various sizes are frequent. The zooecia are large, 0.75 to 1.00 mm in length by 0.55 to 0.65 mm in breadth; distinct, their side walls usually in contact, but frequently more or less separated by small fenestrae, in which case they are connected by short tubular processes. The gymnocyst varies greatly in extent and this accounts almost entirely for the variation in zooecial length; proximal to the opesia there is frequently

a blunt tubercle. The opesia is oval, large, about 0.65 mm long by 0.35 mm wide, the mural rim thin and the descending cryptocyst narrow and granulated. There are usually six spines on each side. Avicularia are few and widely scattered, vicarious on zooeciules, the chamber rather large (about 0.40 by 0.50 mm); the avicularium small, short oval, with an elevated rounded rostrum which is crenated on the distal edge; the mandible semicircular, with strong hinge denticles.

The ooecium has a large circular membranous area on its distal end. This is not due to incomplete growth as the border of the fenestra is thickened and finely beaded and the same characters appear on all of the ooecia. The ooecium is very prominent, hyperstomial, broader than long, averaging 0.30 mm wide by 0.26 mm long, the surface smooth and shining, the proximal edge slightly elevated to form a lip, the aperture not closed by the operculum.

Type, AHF no. 21.

Type locality, Hancock Station 446, James Bay, James Island, Galapagos Island, 54 fms. Also at Sulivan Bay, James Island, and at 450, 0°55′S, 90°30′W, Galapagos, 14 to 60 fms.

Retevirgula areolata (Canu and Bassler), 1923

Plate 7, fig. 6

Mystriopora ? areolata Canu and Bassler, 1923:19.

Zoarium thin, unilaminar, encrusting but loosely attached by the short dorsal tubercular processes of the zooecia; zooeciules of various sizes are of frequent occurrence. The zooecia, while often in contact on the sides, are in general more loosely attached to each other than in *R. lata*; the fenestrae are larger and the connecting tubes longer. Zooecium moderately large, 0.65 mm long by 0.40 mm wide, the gymnocyst is usually well developed, narrowed proximally to the tubular process which connects it with the preceding zooecium. The opesia is distinctly narrower in proportion than in *lata,* elliptical, averaging about 0.55 mm long by 0.26 mm wide. The mural rim is elevated, moderately thin and the cryptocyst narrow and granulated. There are 6 or 7 tall strong spines on each side, the two distal pairs erect and the others leaning somewhat over the opesia. There are also small spines on the avicularian rims. The avicularia are small, rounded, elevated, the mandible semicular and attached by strong hinge denticles.

The ooecia are prominent, but difficult to see among the tall spines, globular and smooth, with a rounded or elliptical fenestra near the middle of the front, width and length about 0.26 mm.

This species differs from *R. lata* in the looser connection of the zooecia, the smaller size, the narrower opesia, the position of the ooecial fenestra and especially by the extensive development of the spines.

This species was described from the Pleistocene of Santa Monica, California, by Canu and Bassler, who were uncertain as to its generic relationships. The ovicell and avicularium are lacking in their material, but the other characters correspond fairly well.

Hancock Stations 1283-41, off Santa Rosa Island, California, 28 fms, 10 colonies on large coralline; Redondo Beach, California, shallow water; Point Vicente, California, 14 fms. Also Monterey Bay, California (Blagg collection).

Family **Chapperiidae** Bassler, 1935

Represented by the one genus, *Chapperia.* Usually this genus has been associated with other membraniporine forms in the Anasca, but Canu and Bassler (1927) separated it widely and placed it under their new suborder Hexapogona on what appears to be a very insufficient character, viz. "The ancestrula engenders six zooecia." It is true that the usual number of buds on the cheilostome ancestrula is five, but the number varies all the way from one to six among the encrusting species, and also varies somewhat within a single species. I have noted as few as four in one colony of *Chapperia patula* (Hincks), and six are occasionally found in other anascan species.

The most unusual character of the group is the presence of "occlusor-laminae" (Harmer), a pair of horizontal projections arising from the lateral walls opposite the operculum and considerably beneath it. They afford attachment for the occlusor muscles of the large operculum; there is much variation in size and in some species they are scarcely noticeable, often obscured by the lateral cryptocyst above them; at their fullest development they may unite to form a continuous shelf around the distal end. Spines, simple, forked or cervicorn, are present on all of our species. Avicularia may be either sessile or pedunculate, and both types are sometimes present on the same colony. The ovicell is hyperstomial, prominent, cucullate and not closed by the operculum. Large multiporous septulae are located rather high in the lateral and distal walls.

The general characters of this group appear to be anascan and I am therefore returning the Chapperiidae to the Anasca following the Alderinidae, to which they seem to have the closest affinity.

Genus CHAPPERIA Willey, 1900

Willey 1900:5, (to replace *Chaperia* Jullien 1881, preoccupied).

This genus has been the subject of much controversy and I shall not be able here to settle the disputed points. Jullien's brief description is as follows: "Two internal calcareous plates, with extremities fixed and serving for the insertion of the retractor muscles of the operculum" (transl. by Canu and Bassler). These plates lie beneath the anterior part of the opesia and usually fuse at their distal ends, sometimes forming a curved shelf. Spines, usually very strong, are present on the distal rim. Avicularia usually present, more or less fused with the distal rim. The operculum, usually well chitinized, occupies much of the opesia. The ovicell is prominent, conspicuous even among the spines, hyperstomial and somewhat cucullate. Genotype, *Flustra acanthina* Quoy and Gaimard, 1825.

Key to Species of *Chapperia*

1. Zooecia large (0.70 to 0.85 mm long), red or brownish, the mural rim widely flared. *patula*
 Zooecia moderate in size, not over 0.60 mm long. 2
2. Spines and frontal processes fuse to form a cover above the opesia. *frontalis*
 Spines simple, not fused, more or less erect. 3
3. Spines very elongate and erect; avicularia elevated on tall pedicels; no pigment. *longispina*
 Spines not usually long, curved or straight. 4
4. Heavily red or brown pigmented; spines stout, proximal pair curved over opesia; opesia broader than long; "cardelles" large. *condylata*
 Slightly brown or not at all pigmented; spines straight; opesia longer than broad; "cardelles" wanting. *californica*

Chapperia patula (Hincks), 1881

Plate 10, figs. 1 and 2

Membranipora patula Hincks, 1881:150.
Membranipora patula, Robertson, 1908:263.
Chapperia galeata, Canu and Bassler, 1923:52 (part, Pl. 34, figs. 9, 10).
Membranipora patula, O'Donoghue, 1923:25.
Amphiblestrum patulum, O'Donoghue, 1926:37.

The zoarium forms rough, reddish brown or reddish purple incrustations on almost anything that will afford attachment, occasionally even on stems; loosely attached, the dorsal side with rough protuberances which have no regularity. The zooecia are large, 0.70 to 0.85 mm long by 0.50 to 0.75 mm wide, ogival in form, the mural rim on the sides expanded, somewhat saucer-shaped, and the distal rim much raised and

thick. The membrane covers the whole frontal surface, as the gymnocyst is vestigial. The heavily calcified, granular cryptocyst is broad proximally and extends around the opesia, narrowly on its distal border. The opesia occupies about half the length of the front, more or less rounded, but usually a little broader than long (length 0.30 to 0.38 mm, width 0.33 to 0.40 mm). Within the opesia, below its distal border is a calcified shelf, the "occlusar-lamina" of Harmer, to which the opercular occlusal muscles are attached. Just above the proximal ends of these laminae are rounded knobs, often wanting, which present the appearance of cardelles, but as they lie much below the level of the operculum, even in the contracted state, their function is problematical. There are four or six tall tubular spines, with dark joints, on the distal rim; rarely one of these is short-bifurcate.

The avicularia are proportionately small, median, triangular, fused with the border of the distal rim and pointing forward (length 0.15 to 0.18 mm); often wanting and apparently never present when there is an ovicell.

The ooecia are large, 0.38 to 0.42 mm wide by 0.26 to 0.30 mm long, hyperstomial, cucullate with a wide open front; the ectocyst does not quite cover the endooecium and leaves a crescentic area next to the border.

Hincks described the species from California and the Queen Charlotte Islands; Robertson listed it from southern California, and O'Donoghue from numerous localities in British Columbia.

In the Hancock collections it is abundantly represented at 38 stations, from the coast of Oregon to Thurloe Head, Lower California; from shallow water to 47 fms.

Chapperia condylata Canu and Bassler, 1930

Plate 10, fig. 5 ♂

Chapperia condylata Canu and Bassler, 1930:44.

The zoaria form reddish to deep purple irregular incrustations on various objects. The zooecia are moderate in size, 0.35 to 0.45 mm wide by 0.40 to 0.50 mm long, ogival in form, the mural rim erect and not spreading out laterally as it does in *C. patula*. The gymnocyst is vestigial, only large enough to support the avicularia in the proximal corners; the cryptocyst broad proximally and extends forward around the sides of the opesia. The mural rim is moderately thick and elevated on the distal border. The opesia is noticeably transverse, 0.28 to 0.30 mm wide by 0.18 to 0.22 mm long, though occasionally more nearly round. Within the opesia are the "occlusar-laminae" and at their proximal ends are

rounded knobs, the "condyles" of Canu and Bassler, which as in *C. patula* appear to be too far below the level of the operculum to serve as hinge denticles; they are often wanting. The avicularia are usually paired in the proximal corners, triangular and directed forward or laterally. When ooecia are present the avicularia are more or less fused with the ectooecium and are directed proximally or laterally. In addition there is often a larger frontal avicularium with a longer triangular mandible; this is occasionally mounted on a tall peduncle. Six distal spines with black joints.

The ooecia are hyperstomial, prominent, with the usual crescentic area around the orifice, length 0.18, width 0.26 mm.

Described by Canu and Bassler from the Galapagos Islands.

Distributed along the coast and about the islands from Santa Catalina Island, southern California, to Colombia and the Galapagos Islands; Thurloe Head, Lower California; San Francisco Island, Gulf of California; Petatlan and Tenacatita Bays, Mexico; Socorro Island, west of Mexico; Pinas Bay, Panama; taken at 28 stations, most common about the Galapagos Islands. Shore to over 100 fms.

Chapperia californica new species

Plate 10, fig. 5

Chapperia galeata, Canu and Bassler, 1923:52 (part, Pl. 34, fig. 8, but not figs. 9 and 10 which are *C. patula*).

Zoarium encrusting stems, or bilaminate, white to reddish brown. Zooecia moderate in size, 0.45 to 0.60 mm long by 0.35 to 0.40 mm wide, often elongate and narrowed proximally; the mural rim thin and high and somewhat flaring in the sides, elevated distally. The cryptocyst broad proximally, continued around the sides of the opesia, granulated. Opesia short elliptical, oval or rounded, but averaging longer than broad, 0.35 to 0.40 mm long by 0.25 to 0.35 mm wide. The occlusar-laminae beneath the distal end of the opesia are rather long, their borders nearly straight and converging at the distal end. The spines are 4 to 6 in number, tall and slender, jointed at the base and more or less directed forward or erected.

The avicularia, frequently wanting, are sessile or slightly elevated, median, directed distally, the mandible short to long triangular (0.08 to 0.18 mm long), with small cardelles; always absent distal to an ooecium.

The ooecium is hemispherical, cucullate, prominent, hyperstomial, with a wide aperture. The usual crescentic area is present above the aperture. The ectooecium is transversely lightly rugose and there are longitudinal small striae, making a faint lattice-work on the surface.

There is considerable resemblance to *C. galeata* (Busk), especially in form of the opesia and the arrangement of the spines, but in the specimens figured and described by Busk and by Jullien from the Falkland Islands (Iles Malouines) the ovicell is always covered distally by an avicularium which presents the form of a crest on the galea. There are no avicularia associated with ovicells on the several colonies which I have studied. Also I find no mention of the decoration of the ectooecium in *C. galeata.*

The figure presented by Canu and Bassler (1923, pl. 34, fig. 8) of Pleistocene specimens from California show no avicularia associated with the ovicells.

Type, AHF no. 22.

Type locality, off San Pedro, California, several colonies encrusting hydroid stems and small worm tubes. In addition there is a bilaminate colony from Station 1250-41, one mile south of San Benito Island, off the coast of Lower California, 28°17′N, 115°35′40″W, at 49 fms; and Stations 1187-40 and 1431-41, off Santa Catalina Island, California. Also a specimen from the Lower Pleistocene at Timm's Point, California (San Pedro), collected by G. P. Kanakoff.

Chapperia frontalis new species

Plate 10, fig. 4

This is a remarkable little species, characterized by the fusion of spinous processes to form a sort of pericyst high above the opesia and extending forward over the aperture and ooecium. The zoarium is encrusting, small, white and shining. The zooecia are small (0.40 mm long by 0.25 mm wide) and very deep so that the zooecia appear to stand almost on end. The opesia is transversely oval, somewhat straighter on the distal border, 0.20 mm wide by 0.15 mm long, its border smooth and little raised. The occlusar-laminae within the aperture are narrow and diagonal. The gymnocyst is short and bears a raised median avicularium with a triangular mandible directed upward and backward. The cryptocyst is a moderate, smooth shelf, extending forward on the sides to the level of the operculum.

The striking feature of this species is found in the nature of the fenestrated frontal cover like a pericyst high above the opesia. There is a pair of long flattened spines opposite the operculum which curve upward and forward, the tips meeting and often fusing. From around the base of the avicularium about 5 (4 to 6) flat, hollow processes extend in a radiating manner, sometimes bifurcating, and fusing with each

other at their tips and also with the large lateral-oral spines to form a shield in which there are several (3 to 5) elongated fenestrae. In addition there is a pair of widely separated distal oral spines which are round and more or less erect; when ooecia are present these spines fuse to some extent with the sides of the ovicells.

The ooecium is characteristic of the genus, large (0.20 mm wide), prominent, cucullate and wide open at the aperture, smooth, and the ectooecium is not quite complete leaving a triangular area immediately above the opening. The fused tips of the lateral-oral spines sometimes extend beyond the ovicell. Reproduction begins early in the colony formation with the second or third row of zooecia; the largest colony consists of only 36 zooecia of which 24 bear ovicells.

The ancestrula is membraniporoid, the opesia occupying the whole of the front, and with 3 rather strong erect spines on each side.

Type, AHF no. 23.

Type locality, Sta. 473, off Hood Island, Galapagos, 1°22′40″S, 89°37′00″W, 75 fms, two colonies on a cinder. Also at Sta. 461, off Tagus Cove, Albemarle Island, Galapagos, 80 fms, one colony on a coral fragment; and Sta. 406, 1°03′30″S, 90°17′30″W, 60 fms, one colony on a coralline fragment.

Chapperia longispina new species

Plate 10, figs. 6 and 7

Zoarium encrusting, white, the zooecial characters, obscured by the close array of tall, slender white spines. The zooecia are of moderate size, 0.45 to 0.60 mm long by 0.40 to 0.45 mm wide; closely set; the walls high but not conspicuously flaring. The gymnocyst is usually limited to the area covered by the base of the avicularium; the cryptocyst broad proximally, decreasing in width to the level of the operculum; the opesia is more or less rounded (about 0.30 mm in each dimension), the occlusar-lamina moderately developed and no indication of condyles. There are usually 4, occasionally 6, tall, tubular oral spines, slender only in comparison with their length, the longest measuring as much as 0.90 mm, the average being about 0.70 mm. The spines are all nearly erect, never more than slightly curved, and the distal pair is not lost in the presence of an ovicell.

The avicularia are of two kinds. In the absence of an ovicell the avicularium on the basal gymnocyst is only slightly elevated and has a short-triangular mandible. When an ooecium is developed, the avicularium distal to it rises in tubular form to the height of the ooecium; the

mandible is irregularly spatulate and broadened at the tip; the edge of the rostrum often becomes irregularly spinulose. Also from the base of the avicularian chamber lateral furcate spinose processes are developed. The erect chamber or pedicel may be free or it may be fused with the ectooecium. Its nature is very similar to that described by Busk (1884: 78) and Waters (1888:12) for *C. (Electa) cylindracea.*

The ovicell is typical of *Chapperia,* rounded, prominent, cucullate, smooth, but the ectooecium is more complete than in most other species; it measures about 0.26 mm in width.

By the similarity of the avicularia this species appears to be most nearly related to *C. cylindracea* (Busk) from the Indian Ocean, but it differs in the nature of the spines which are much longer and entirely unmodified; in the absence of a widely flaring mural rim, and in the narrower cryptocyst, as well as in the form of the avicularian mandible.

Type, AHF no. 24.

Type locality, Hancock Sta. 1385-41, 13 miles SSE of East Point, Santa Rosa Island, southern California, 75 fms. Two colonies, one encrusting a hydroid stem and the other on a shell fragment.

? Chapperia varians (O'Donoghue), 1923

Membranipora varians O'Donoghue, 1923:29.
Chaperia varians (O'Donoghue), 1926:40.

The generic relationship of this species is in doubt, due to the lack of important characters in the description. Ovicells were not found and there is no mention of the nature of the communication pores nor of the method of attachment of the opercular muscles. O'Donoghue transferred it from *Membranipora* (where it cannot belong) to *Chapperia* at Waters' suggestion, but it might as well be a *Callopora* or *Hincksina.* Whatever it is, it appears to be a good species, and I append a brief list of the characters in the hope that some one may later recognize it and have sufficient material to complete the description.

A smooth thin cryptocyst occupies about one-third of the frontal area; the opesia is oval with a thin, low rim and occupies nearly all of the remaining front; a few small lateral and distal spines are present; a proximal avicularium is borne on a short truncated conical base in the midline (suggesting *Chapperia*) and a minute stalked avicularium is situated on either side opposite the operculum. Off Protection Gap and off Snake Island, British Columbia (O'Donoghue).

Family **Arachnopusiidae** Jullien, 1888

An arched calcified frontal shield or pericyst which is perforated by numerous large pores above the membranous ectocyst. The pericyst is formed by irregular projections originating from the lateral and proximal margins. Levinsen (1909:160) states that the projections in *Arachnopusia* are at first hollow spines which later become solid. In the other two genera here considered there is no evidence of hollow spines at any time.

There is much uncertainty whether these two genera belong with *Arachnopusia,* and also whether the family is properly placed. It is possible that it should be included among the cribrimorphs, but the pericyst is not formed of parallel or radial costae.

Genus **EXECHONELLA** Canu and Bassler, 1927

"The frontal pores are orbicular. A peristome very much developed, surrounds an orifice closed by a true operculum. The ectocyst is hidden under the frontal" (Canu and Bassler, 1926:4). Genotype, *Hiantopora magna* MacGillivray, 1895.

The external appearance is that of a member of the Ascophora, but careful dissection exposes the ectocyst which covers the full breadth of the opesia beneath the pericyst. The dorsal wall is provided with tubular processes for attachment.

Exechonella antillea (Osburn), 1927

Plate 10, figs. 9 and 10

Lepralia antillea Osburn, 1927:128.
Exechonella pumicosa Canu and Bassler, 1928:70.
Exechonella antillea, Osburn, 1940:366.

Zoarium encrusting on shells, corals, etc., forming a coarse yellowish or grayish layer; attached by dorsal processes, one or more on each zooecium. Zooecia large, 0.70 to more than 1.00 mm in length by 0.60 to 0.70 mm in width; well separated by deep grooves even in older stages. The whole area of the gibbous pericyst is coarsely perforated, each pore being surrounded by a broad collar. A thick-walled peristome, usually considerably elevated but lower on the proximal border, often bearing tubercles, and occasionally the whole rim flared outward. The aperture is large, about 0.20 to 0.25 mm in either dimension, varying in form but usually slightly quadrate with the corners rounded. The operculum is

well chitinized, with a pair of strong sclerites which reach forward from the heavy cardelles; it is complete on the proximal border, but is attached to the ectocyst from which it is easily separated; in dried or alcoholic specimens the contraction usually detaches it from the ectocyst. There is a row of uniporous septulae in the lateral and distal walls. No ovicells.

Osburn described the species from Curacao Island in the southern Caribbean Sea and in the following year, before the description of *antillea* was available, Canu and Bassler named it *pumicosa* from southern Florida. It is widely distributed in the West Indian region. Pacific coast specimens appear to agree in every particular.

Albatross Stations: D.2824 and D.2825, Gulf of California.

Genus ANEXECHONA new genus

Zoarium encrusting, often multilaminar, rarely with erect, flat branches. Frontal wall a pericyst, with large funnel-shaped pores, above the frontal membrane or ectocyst which covers the whole opesia; peristome wanting, the operculum on a level with the zoarial surface; side walls with multiporous, the distal wall with uniporous septulae. Avicularia large, vicarious, occupying a place in the zooecial series. No spines nor tubercles. No ooecia. Genotype, *Anexechona ancorata* Osburn, new species.

This genus is evidently related to *Exechonella* by the manner of forming the porous pericyst, which grows inward from all sides without any evidence of spines. It differs in the absence of a salient peristome, in the nature of the operculum, and in the presence of large vicarious avicularia. Since Canu and Bassler selected the name *Exechonella* because of the raised peristome, I am adopting *Anexechona,* not salient, for the present genus.

Anexechona ancorata new species

Plate 11, fig. 1

The zoarium encrusts shells, stones and occasionally algae; often several layers in thickness, rarely erect and bilaminate, back to back; dorsal surface smooth; frontal surface flat and smooth; light yellow to brownish in color.

Zooecia distinct, but the interzooecial grooves very shallow; the brown opercula and avicularian mandibles standing out prominently. The zooecia are large, 0.65 to 0.80 mm long by 0.40 to 0.50 mm wide; the frontal nearly flat, consisting of a smooth pericyst with large infundibular pores evenly arranged. The region about the aperture is

slightly higher, but there is no peristome and the operculum is at the level of the frontal surface except at the proximal border where it drops slightly below. The aperture is large, about 0.18 mm long by 0.20 mm wide, subquadrangular, nearly straight on the sides with the proximal and distal borders slightly arcuate; the strong cardelles situated about one-third of the way from the proximal border. The operculum is brownish with a heavy dark brown band continuous around the border; proximally it is attached to the ectocyst but is easily separable from it.

The avicularia are unusually large, interooecial, scattered, occupying a place in the zooecial series, the chamber 0.60 to 0.80 mm long by 0.40 to 0.50 mm wide; the dark brown mandible usually from 0.40 to 0.50 mm long, spatulate in form, with 3 strong unguiculate teeth at the end and 2 or 3 smaller ones along the sides, somewhat resembling a grappling hook; it is broadened at the base and attached to a strong pivot.

No ovicells, no spines.

Type, AHF no. 25.

Type locality, Hancock Station 1049-40, Angel de la Guardia Island, Gulf of California, 29°32′47″N, 113°34′35″W. Also dredged at Stations 650-37, San Francisco Island and 2180, off Magdalena Bay, Gulf of California; 136-34, Clarion Island, west of Mexico; 217, Tenacatita Bay, Mexico; 468-35, Port Parker, Costa Rica and "off Colombia." Also Albatross Sta. D.2825, Gulf of California. Shore to 50 fms.

Family **Hiantoporidae** MacGillivray, 1895

In the genus *Hiantopora* MacGillivray, 1887, there is a pericyst formed by the fusion of branching spines above the ectocyst; these often form an almost complete cover, with large irregular pores. Marginal and interzooecial avicularia may be present. Dorsal tubular processes are for attachment. The ovicell is not closed by the operculum.

Tremopora Ortmann, 1890 is similar in appearance to *Hiantopora,* but the spines are less developed, the ectocyst more exposed, and the ovicell is closed by the operculum.

In *Tremogasterina* Canu, 1911, the pericyst is formed in a different manner, there is no evidence of origin from spinous processes and the front is solidly bridged over except for the presence of 2 or 3 large central pores. The ovicell is hyperstomial and closed by the operculum.

The first two genera are apparently closely associated, but *Tremogasterina* differs so much that its position is questionable. Like the cribrimorphs and the Arachnopusiidae it has an external resemblance to the Ascophora, but the ectocyst extends over the opesia beneath the pericyst.

Genus **TREMOGASTERINA** Canu, 1911

The ovicell is hyperstomial and closed by the operculum. The aperture bears two small cardelles; the operculum, often chitinized, is attached to the ectocyst. The frontal is a pericyst extending over the ectocyst or frontal membrane; the central area is perforated by 2 or 3 large reniform or rounded pores. Large avicularia arise from the lateral walls and assume an interzooecial appearance. Genotype, *T. problematica* Canu, 1911.

Tremogasterina granulata var. **subspatulata** new variety

Plate 10, fig. 8

Zoarium encrusting, usually on sponges, usually unlaminar, white to light yellow in color, often covering several square inches.

Zooecia ventricose, distinct with deep separating grooves in the young stage, but becoming nearly level with increased calcification. On both sides and around the proximal end there is a row of rather large rounded pores, resembling the areolar pores of the Ascophora, and from the distal pore on one side arises the avicularian chamber; with increased calcification the frontal outlets of the pores of neighboring zooecia usually unite so that there seems to be but one row, a fact which no doubt explains the statement of Canu and Bassler (1929:119) in regard to *T. celleporoides* (Busk) that "there is only a single range (of pores) between two adjacent zooecia." In balsam mounts of marginal zooecia the two rows are very distinct in the youngest zooecia and in older ones the separate pores may be seen at the bottom of the single opening. Even the secondary pores often become completely closed off in older zooecia.

The frontal is a pericyst, above the frontal membrane, and appears to be formed in a different manner than any other pericyst. Acicular spicules are laid down inside from the zooecial walls, at first conforming to the "areolae," then becoming concentric about the central pores, while more distally they conform to the aperture and even extend around it on the distal border. When first formed this layer is thin and smooth, but it very soon becomes heavily calcified and much roughened, and the furrows between the zooecia are filled; the depression about the central pores remains evident at all stages. The whole process resembles the formation of the olocyst and pleurocyst of the Ascophora, as first stated by Canu and Bassler (1928:44) and later (1929:117) corrected by them.

The aperture is somewhat quadrate, the sides straight, the distal end rounded, the proximal end slightly arcuate and broader, length 0.22 to 0.26 mm, width 0.18 to 0.20 mm; peristome low and very thin with 2

to 4 small distal spines; a pair of strong cardelles; the pericyst forms a thick, low wall around the peristome but without fusing with it. The operculum is well chitinized, with a narrow border and a pair of heavier sclerites which extend forward from the cardelles within the lateral borders and meet at some distance back of the distal border. The operculum is connected with the frontal membrane, but is detachable.

The large elongate avicularia are so regularly disposed between the zooecia that they appear to alternate with them in series, but they are interzooecial only in arrangement and not vicarious, as shown by their manner of budding and by the fact that the avicularian chamber does not descend below the level of the primary layer of the pericyst. The mandible is elongate and narrowly spatulate, its tip much decurved with its point usually fitting into the central depression; a triangular lucida in its base, and hinged to strong cardelles which occasionally meet to form a bar; the mandible measures 0.35 to 0.50 mm long by 0.13 to 0.16 mm wide at the base.

The ovicell is rounded, about 0.25 to 0.30 mm wide; at first prominent, but later becoming immersed, the surface roughly reticulate; closed by the operculum.

There is close agreement between the typical *granulata* Canu and Bassler, 1928:45, from the Florida Straits, and the present variety in all points, except in the avicularia which are broader, the sides parallel to near the tip which is suddenly rounded at the hooked beak.

Type, AHF no. 26.

Type locality, Hancock Station 136-34, Clarion Island, 18°20′05″N, 114°44′40″W, 32 fms. Also at Station 137-34, Clarion Island, and 539 -36, Angeles Bay, Lower California, 20 fms.

Division III COILOSTEGA Levinsen, 1909

In this group the horizontal lamina of the cryptocyst is highly developed, in some cases even extending forward around the aperture, and above this lies the frontal membrane. The lateral muscles which operate the membrane pass downward to the dorsal wall distally to the lamina, or through notches at the sides, or through special foramina at either side known as the opesiules. When the opesiules are well developed the distal end of the polypide is more or less enclosed in a calcified polypide tube. Avicularia or vibracula are usually present and always interzooecial. Ooecia may be either hyperstomial or endozooecial.

Key to Families

1. Ovicells hyperstomial. 2
 Ovicells endozooecial or wanting. 3
2. Ovicells very large, very prominent; avicularia large, replacing zooecia; opesiules closed. Thalamoporellidae p.110
 Ovicells normal in size and appearance; opesiules joining the opesia (sometimes scarcely evident); avicularia smaller (sometimes wanting) Aspidostomidae p.114
3. Zoarium discoidal, free, saucer-shaped or short conical; distal to each zooecium is an auriculate avicularium with long setose mandible. Lunulariidae p.112
 Zoarium encrusting; avicularia replacing zooecia. 4
4. Zooecia of two kinds, one with a much enlarged operculum; polypide tube complete. Steganoporellidae p.107
 Zooecia of one kind; avicularia various; polypide tube incomplete. Microporidae p.100

Family **Microporidae** Hincks, 1880

There is much variation in the extent of the cryptocyst in this family and the opesial area may be moderately large or nearly wanting except for the opesiules, which may be separated from the opercular area (closed) or united with it (open). Avicularia may be large or small, sometimes with long slender mandibles which are winged on one or both sides at the base (onychocellaria). The ooecium when present is endozooecial.

Key to Genera of Microporidae

1. Avicularian mandible winged at the base (onychocellarium), subfamily Onychocellinae. 2
 Avicularian mandible not winged, Subfamily Microporinae. . . 4
2. Avicularian mandible falciform, asymmetrical with wing on one side. *Onychocella*
 Avicularium symmetrical or wanting. 3
3. Opesiular notches very distinct, directed laterally. . . . *Floridina*
 Opesiular notches shallower and directed more proximally. *Velumella*
4. No avicularia; opesiules long parallel slits. *Caleschara*
 Avicularium small, distal to aperture; cryptocyst complete except for the aperture and very small opesiules. 5
5. Encrusting, ovicells conspicuous but endozooecial. . . *Micropora*
 Erect and branching, no ovicells. *Microporina*

Genus **ONYCHOCELLA** Jullien, 1882

The cryptocyst is extensive, depressed, not differentiated from the oral shelf and continued broadly around the distal border of the aperture; opesia reduced to little more than the orifice, opesiules open, often in-

distinct. Avicularia more or less asymmetrical, cryptocyst not divided, the wing developed on one side of the mandibular rachis.

The species under discussion, *O. alula,* does not quite conform to the generic description, as the rachis is usually straight and there is occasionally a vestigial wing opposite to the developed one. Otherwise it agrees with the genotype, *O. marioni* Jullien, 1882.

Onychocella alula Hastings, 1930

Plate 11, figs. 5 and 6

Onychocella alula Hastings, 1930:715.

Zoarium encrusting yellow to brown in color. The zooecia are irregularly hexagonal, distinct; cryptocyst depressed and tuberculate, continued around the sides and in front of the aperture; proximal border of the aperture nearly straight, the opesiules indistinct. The operculum is well chitinized, brown, with a bordering sclerite except proximally, and it is well separated from the cryptocyst; it is surrounded at a little distance by a chitinous framework which extends proximally to contact with the cryptocyst. The avicularian chambers are symmetrical and without a raised rostrum; opesia single and variable in size and form; the mandible thin and straight, strongly hooked at the tip, sharply marked off from the triangular base and toothed on the under side nearly its whole length; wing narrow, very delicate and extending nearly to the tip, occasionally a trace of a wing on the opposite side.

Measurements: zooecial length 0.45 to 0.50, width 0.35 to 0.40 mm; onychocellaria length 0.35 to 0.40 mm, width 0.20 mm; length of mandible 0.40 to 0.50 mm.

Dr. Hastings recorded the species from Gorgona, Colombia, and Balboa, Canal Zone, 15 fms.

Hancock Stations: 23-33, La Plata Island, Ecuador, 10 fms; 114, Catalina Island, southern California, 41 fms. Also Panama, Galtsoff collection, Sta. 23, covering several square inches on a pearl oyster shell.

Genus FLORIDINA Jullien, 1881

The cryptocyst is nearly complete, extending around the aperture, with a strong angular process on each side; the opesiules are large and usually very evident, marked off by the angular processes and extending laterally from the proximal end of the aperture. There is much variation in the form of the opesia. The avicularian chambers (onychocellaria) are straight, without a distal canal and rounded at the tip; the mandible is broadly and equally bimembranous. Genotype, *Mollia antiqua* Smitt, 1873.

Floridina antiqua (Smitt), 1873

Plate 11, fig. 4

Mollia antiqua Smitt, 1873:12.
Floridina antiqua, Canu and Bassler, 1928:60.
Floridina antiqua, Hastings, 1930:715.
Floridina antiqua, Osburn, 1947:17.

Zoarium encrusting, usually on shells. Zooecia of moderate size, rather broad, length 0.40 to 0.50 mm by 0.35 to 0.40 mm in width; the onychocellarium 0.35 to 0.40 mm in length; mandible about 0.25 mm long; all of the measurements vary greatly. The granulated cryptocyst rises slightly proximal to the aperture as if to form the roof of an incipient polypide tube; it extends for half the length or more of the zooecium and is continued broadly all around the aperture, forming on each side of the latter a strong projection, partly cutting off the opesiules and forming a somewhat trifoliate opesia. The operculum is situated in advance of the cryptocystal process; it is rather thin with a bordering sclerite except on the proximal border where it is continuous with the frontal membrane. The onychocellarium is moderately elongate, usually ovoid at the proximal end and pointed distally; there is much variation in their distribution and frequently they may be absent over much of the zoarium; the mandible is dark brown and strongly hooked; the two wings are very fragile and symmetrical, forming an oval.

Smitt identified the species with *Membranipora antiqua* Busk, but pointed out the differences and gave an excellent figure. He recorded it from Florida at 36 fms. Canu and Bassler listed it from the Gulf of Mexico, the Straits of Florida and south of Miami, Florida, down to 56 fms. and Osburn found it at several stations in the southern Caribbean. On the Pacific coast it has been recorded only by Hastings, from Gorgona, Colombia.

Hancock Stations: It is a fairly common species, taken at 25 stations, ranging from Cedros Island (N Lat. 28°) on the west coast of Lower California and Angel de la Guardia Island (N Lat. 29°) in the Gulf of California, to La Libertad and La Plata Island, Ecuador (1°15′S Lat.) Intermediate localities are Isabel Island, Tenacatita Bay and Petatlan Bay, Mexico; Socorro and Clarion Islands, west of Mexico; and Gorgona and Port Utria, Colombia. The bathymetric range extends from the shore line to 55 fms.

Genus **VELUMELLA** Canu and Bassler, 1917

"The retractor muscles of the polypide are attached in the median axis of the zooecium; the opesiular indentations are symmetrical. The onychocellaria are straight, without distal canal; the rachis of the mandible bears two broad membranes; the opesium of the onychocellarium is elliptical and entirely denticulated" (C. and B.) Genotype, *Onychocella levinseni* Canu and Bassler, 1917.

Velumella americana Canu and Bassler, 1928

Plate 12, figs. 7 and 8

Velumella americana Canu and Bassler, 1928:54.
Vincularia abyssicola Smitt, 1873:6 (part, fig. 60, not 61).
Smittipora abyssicola, Osburn, 1914:195; 1927:125.
Velumella americana, Osburn, 1947:17.

Zoarium encrusting, yellowish to light brown in color. Zooecia rather large, 0.70 to 0.80 mm long by about 0.45 mm wide, distinct with a deep furrow; mural rim thin and somewhat elevated; cryptocyst depressed, smooth in younger stages, becoming granulated with age. The opesia is moderately large, measuring about 0.25 mm in either dimension, the proximal border more or less straight, the opesiular indentations distinct. The onychocellarium is about as long as the zooecia, but usually narrower; its opesia is long oval, narrower proximally and crenulate; the mandible is long, 0.60 to 0.65 mm, curved at the tip, and with two membranous wings which together form an oval with the point forward; the base of the rachis is broad, 0.20 mm, triangular and bears a triangular lucida. Ovicell small and endozooecial, not conspicuous.

The species is common and well distributed in the West Indian region. Our Pacific specimens do not seem to differ, except in the heavier granulation of the cryptocyst.

Hancock Stations: 170-34 and 401, Chatham Island, Galapagos, 17 to 32 fms. Also Gulf of Panama, Galtsoff collection, on pearl oysters.

Genus **CALESCHARA** MacGillivray, 1880

This genus has been redefined by Harmer (1926:221) as follows: "Frontal membrane occupying the entire surface, the operculum small and Membraniporine. Spines wanting. Cryptocyst extensive, imperforate, tuberculate, its proximal part produced into a Steganoporelliform median process, free distally or uniting with the lateral cryptocyst. Opesia trifoliate, or opesiules complete, according to the character of the median

process. Avicularia wanting. Ovicells entozooecial, large. Communication-plates uniporous septula." Genotype, *Eschara denticulata* MacGillivray, 1868.

Harmer places the genus "in the Membraniporine series" apparently allying it to *Acanthodesia,* and Silen (1929:134) appears to agree with this arrangement. Canu and Bassler (1929:134) assign it to the Opesiulidae, assuming that the anterior process of the cryptocyst is an incomplete polypide tube. It certainly has this appearance since it is transversely convex and flared upward at the tip. The large endozooecial ovicell would seem to remove the genus from any close association with *Acanthodesia.*

Caleschara mexicana new species

Plate 11, fig. 11

Zoarium encrusting in a thin layer, flat and white. Zooecia of moderate size (0.40 to 0.50 mm long by about 0.26 mm wide), separated by very narrow shallow grooves, the sides nearly parallel. The mural rim is thin, regularly beaded; gymnocyst not evident; the cryptocyst is coarsely granulated and fills the proximal half of the front, extending narrowly around the distal border of the aperture. The anterior process of the cryptocyst extends nearly to the aperture, transversely convex (like the roof of a polypidian tube), the tip elevated and somewhat spatulate and bordered by numerous lateral spinules which give it a slightly fimbriate appearance. The opesiules are open, elongate and somewhat slit-like, the outer border crenulate and often with a few spinules; usually there is a pair of larger spinules in the position of cardelles. At each proximal corner of the cryptocyst there is a smooth, shining, subglobular tubercle, occasionally wanting on one or both sides. No avicularia; no dietellae, and in our specimens no ooecia have been observed.

This species appears to be rather close to *C. levinseni* Harmer (1926: 221) but that species is evidently larger (Harmer merely states "zooecia large") and appears to lack the horizontal spinules of the process and opesular borders.

Type, AHF no. 28.

Type locality, Mazatlan, Mexico, 23°09′N, 106°23′W, shore collection, 4 colonies encrusting the smooth surfaces of shells. (Miss A. E. Blagg, collector.) Also from Panama, Galtsoff collection, Sta. 23, several colonies covering the whole inside of a pearl oyster shell, an area about 75 mm in either direction.

Genus **MICROPORA** Gray, 1848

Zoarium encrusting. Zooecia with an elevated mural rim which ends in a knob-like enlargement on either side of the aperture. Cryptocyst covering the entire frontal area except the aperture and small opesiules. Ovicells endozooecial but very prominent. A small avicularium just distal to the aperture. Genotype, *Flustra coriacea* Esper.

Micropora coriacea (Esper), 1791

Plate 11, fig. 3

Micropora coriacea, Hincks, 1884:12.
Micropora coriacea, Robertson, 1908:275.
Micropora coriacea, O'Donoghue, 1923:30; 1926:49.
Micropora coriacea, Canu and Bassler, 1923:58.
Micropora coriacea, Hastings, 1930:719.

Zoarium encrusting. Zooecia usually very regularly disposed, short and broad, somewhat hexagonal in outline; mural rim high and thin, but ending in a small knob-like structure at the sides of the aperture; cryptocyst flat, depressed distally to the level of the minute opesiules and then suddenly elevated to the proximal border of the aperture. The operculum is semicircular. A small avicularium is situated just distal to the zooecium, often wanting over much of the zoarium. The ovicells are large, elongate, conspicuous and endozooecial.

Distributed around the world in warmer and temperate waters; common at many places in the Gulf of Mexico and the Caribbean Sea. On the Pacific coast it is known from British Columbia (Hincks and O'Donoghue), Santa Catalina Island, California (Robertson), and the Galapagos Islands (Hastings).

In the Hancock collections it is represented at 56 stations all along the coast from the Channel Islands, California, to the Galapagos Islands and the coast of Peru.

Genus **ROSSELIANA** Jullien, 1888

"*Flustra rosselii* Audouin, qui a son cryptocyste à moitié developpé et son orifice semicirculaire (type du genre *Rosseliana*), n. gen." Jullien, 1888:78.

Canu and Bassler, 1920:288, accept this genus and place it in the family Microporidae, with the additional description: "The frontal of the zooecium is a cryptocyst of little depth. The opesium is semicircular. The ovicell is endozooecial but prominent. Septulae uniporous. No avicularia." Genotype, *Flustra rosselii* Audouin, 1826.

Rosseliana rosselii (Audouin), 1826

Membranipora rosselii, Hincks, 1884:7.

"Houston-Stewart Channel, British Columbia, on shells, not uncommon," Hincks. The species has not been found on the Pacific coast since, nor has it been reported from any areas except the Mediterranean and western Europe.

Genus MICROPORINA Levinsen, 1909

Erect colonies, often branching profusely to a height of several inches; jointed, the internodes terete, tapered at the proximal end and rounded at the tip. Zooecia with the cryptocyst filling the frontal area nearly to the aperture which is almost semicircular; in younger stages small opesiules may be seen but these are usually closed by later calcification. A small avicularium occurs just distal to the aperture. No spines. No ovicells. Genotype, *Salicornaria borealis* Busk, 1855.

Microporina borealis (Busk), 1855

Plate 11, fig. 2

Cellaria borealis, Robertson, 1900:322; 1905:287.
Cellaria borealis, O'Donoghue, 1923:23.
Microporina borealis, O'Donoghue, 1926:49.

Zoarium erect and branching, often in luxuriant growth several inches in height; the rounded internodes averaging about 1 cm in length, the joints chitinous. The zooecia are moderately large, about 0.75 mm long by 0.30 mm wide, arranged in 12 to 16 rows around the internode, alternating regularly so that they appear to form spiral as well as longitudinal series. The margins are little raised, more so about the distal end. The front, beneath the ectocyst, is a flat porous cryptocyst which fills the whole front almost to the operculum. The aperture is nearly semicircular, slightly rounded on the proximal border. Distal to the aperture and in line with it is a small avicularium with the triangular mandible directed proximally. There are no ovicells.

It is a northern species abundant in Greenland waters, but ranges south on the Pacific coast from Bering Sea to British Columbia (Robertson and O'Donoghue).

A couple of small fragments occurred in the Dall collection labeled only "Bering Sea." Also at Point Barrow, Alaska, 14 fms, G. E. MacGinitie, collector, Alaska Research Laboratory.

Family **Steganoporellidae** Smitt, 1873

The zooecia are dithalamic, the cavity more or less divided by a cross-wall or partition, the descending lamina of the cryptocyst, into proximal and distal cavities. The horizontal lamina of the cryptocyst is complete above the proximal cavity; the descending lamina perforated by the polypide tube, which is more or less calcified, sometimes only the roof of the projecting distal portion being calcified. The opesia is confined to the distal cavity and is further limited to a greater or less extent by the surrounding cryptocyst. In the genus *Steganoporella* there are two kinds of zooecia, the "B" zooecia having an enlarged operculum provided with chitinous teeth, apparently an incipient avicularium. In other genera, *Labioporella* and *Siphonoporella,* there are large vicarious avicularia which replace zooecia in the series.

Genus **STEGANOPORELLA** Smitt, 1873

This genus is distinguished from others in the family by the presence of two kinds of zooecia. Among the ordinary zooecia (A type) there are others (B zooecia) which resemble them in most respects but which have a much enlarged operculum with a heavy chitinous border beset with chitinous teeth and which are undoubtedly incipient avicularia. Genotype, *Steganoporella (Steginoporella) legans* Smitt (=*Membranipora magnilabris* Busk).

Steganoporella cornuta new species

Plate 12, figs. 3, 4, 5 and 6

Zoarium encrusting, pale yellow. Zooecia of moderate size, 0.65 to 0.75 mm long by 0.40 to 0.65 mm wide, elongate-hexagonal, distinct; mural rim high, especially at the distal end, moderately thick and finely granulated. A salient, strong, pointed tubercle at each distal corner. Cryptocyst coarsely granulated, the main lamina extending about half the length of the zooecial cavity, descending gradually; the frontal process is elevated slightly and united with the roof of the polypide tube. The remainder of the polypide tube is uncalcified. The frontal process is not connected with the lateral walls and there is an elongated open opesiule on each side symmetrically; the process, except for its tip, is granulated like the remainder of the cryptocyst, which is continued narrowly around the opesia.

The operculum is thin, with a heavy border sclerite which bears a strong flange on either side a little above the point of attachment to the condyles; no marginal teeth, length 0.13 mm, width 0.18 mm.

The B zooecia, to use Harmer's term for the slightly modified avicularian zooecia, are not larger than the largest of the normal zooecia, but are broader distally to accommodate the large operculiform mandible; the cryptocystal lamina is shorter and the frontal process also, leaving a much larger opesia; the distal mural rim is raised into a shallow hood and the tubercles are wanting at the distal corners. The mandible (B operculum) is rounded distally and on the sides, well chitinized; the main sclerites are only slightly arcuate outward, running from the condylar attachment to the distal border where they fail to meet by about 0.07 mm, the gap being bridged by a thinner extension of the chitin. There are no teeth on these sclerites, but there is a strong flange a little beyond the point of attachment to the condyles. An accessory strong rib curves inward proximally from a short distance above the attachment and reaches the proximal border where it is connected with the ectocystal sclerite on each side. The border sclerite is heavy distally, where it bears 8 strong, short teeth, but fades out before reaching back to the condyles. The mandible is somewhat intermediate between the U and V or Y types of Harmer. It measures 0.26 mm long by 0.30 mm wide.

Because of the uncalcified polypide tube, except for the roof, the lack of lateral connections with the frontal process, and the narrow circumopesial cryptocyst, this appears to be a very primitive member of this genus. There can be no doubt of its generic relationships, however, since the differentiation of the A and B zooecia is characteristic. Harmer (1900:253) described *S. simplex* from the Amirante Islands, which resembles *cornuta* in the characters just mentioned, but which is otherwise very different.

Type, AHF no. 27.

Type locality, off Acapulco, Mexico, 15 fms, Captain Fred S. Lewis, collector. Also Gulf of Panama, Galtsoff collection, on shells of pearl oysters, (station 26, Coiba, Canal Coibita, northern end, south of Isla Rancheria).

Genus **LABIOPORELLA** Harmer, 1926

Labiopora Levinsen, 1909:171, 174 (preoccupied).

Zooecia with distinctly raised walls. Gymnocyst wanting. Cryptocyst porous, not extending as a shelf around the opesia. A vertical cryptocystal lamina separates the proximal and distal cavities, perforated near the middle by the polypide tube; inner borders of the walls heavily granulated or crenulate. Avicularia large, vicarious, with spatulate mandibles. No ooecia. Multiporous septules present. Genotype, *Labiopora crenulata* Levinsen, 1909.

Labioporella sinuosa Osburn, 1940

Plate 11, fig. 12

Labioporella sinuosa Osburn, 1940:377.

Zoarium encrusting rather loosely on various surfaces, yellowish to light brown, white and glistening in the absence of the ectocyst. Zooecia with sinuate lateral walls when crowded or on rough surfaces, but perfectly regular and with parallel walls when growth conditions permit. The walls are elevated, the mural rim delicately beaded, the inner border of the walls coarsely beaded even on the distal wall. Gymnocyst wanting. The cryptocyst covers the entire proximal chamber with a thick, perforated and granulated layer, which ceases abruptly at the descending lamina. Distal to this the cover of the polypide, longitudinally rugose, with the tip elevated and finely crenulate, projects for a short distance; this is connected with the lateral walls by a narrow shelf which is imperforate. The descending lamina of the cryptocyst is vertical, straight, complete except for the perforation of the polypide tube, and divides the zooecial cavity into two subequal chambers. The distal wall is slightly arched on the dorsal side, strongly on the frontal side and overlies the base of the distal zooecium; on the proximal side of the distal wall just beneath the tip of the operculum is a distinct rounded tubercle. The operculum is longer than wide (0.15 by 0.13 mm), with a dark brown border sclerite, widely separated from the walls on the sides but nearly touching the distal wall. Multiporous septulae present. No ooecia. No ovicularia have been observed in either Atlantic or Pacific specimens from various localities.

Originally described from the Tortugas Islands, Gulf of Mexico, the species proves to be well distributed on the Pacific coast from the Gulf of California to Ecuador. It appears to be nearly related to *L. spatulata* Harmer, 1926:283, but it differs from Harmer's description and illustration (pl. 21, fig. 6) in the presence of coarse crenulation on the inner border of the walls, even around the distal end; in the form of the operculum which is noticeably longer; the descending lamina is always simple, and the tubercle beneath the operculum is never doubled or tripled. The complete absence of avicularia renders it difficult to ally this form with any of the other species, which have been described from Ceylon, Australia, the East Indian region and Japan. Possibly the absence of avicularia may be a specific character, since none have been found throughout the range on either coast.

Hancock Stations: 596-36, 599-36, 637-37, 650-37 and Albatross sta-

tions 2824 and 2825, all in the southern part of the Gulf of California; 132-34, Socorro Island and 136-34, Clarion Island, west of Mexico; and 212-34, La Plata Island, Ecuador. Also Gulf of Panama, Galtsoff collection on pearl oysters. The known range on the Pacific coast is from 25° 57′00″N, in the Gulf of California, to 1°15′00″S, Ecuador; shore down to 47 fms.

Family **Thalamoporellidae** Levinsen, 1909

Levinsen, 1909:175-178, gives an extended discussion which it is not necessary to repeat here. The opesiules are closed, often unsymmetrical in size and form and often extend to the dorsal wall; the cryptocyst extends far forward leaving a rounded opesia, most of which is occupied by the operculum. At the side of the operculum are adoral areas, often vestigial, which may bear tubercles. In the body cavity occur peculiar spicules shaped like wide-open compasses and curved calipers. The avicularia are large, replacing zooecia in the series. Ooecia very large and prominent, somewhat bilobate, and closed by a special membrane.

Genus **THALAMOPORELLA** Hincks, 1887

Characters of the family. Genotype. *Flustra rozieri* Audouin, 1826.

Thalamoporella gothica (Busk), 1856

Plate 12, fig. 1

Membranipora gothica Busk, 1856:176.
Thalamoporella rozieri var. D (*gothica*) Levinsen, 1909:184.
Thalamoporella gothica, Harmer, 1926:302.

Zoarium encrusting or erect. Zooecia large (0.80 to 1.10 mm long by 0.30 to 0.50 mm wide), the sides usually parallel. The cryptocyst covers two-thirds or more of the front, thickly perforated to the level of the opesiules. The opesiules are large, often differing in size, the wall of one usually descending to the dorsal side. The opesia is distinctly sinuate on the proximal border, 0.30 to 0.35 mm in each dimension, occasionally with adoral tubercles on the side, but usually the aperture occupies the full width within the mural rim and leaves no adoral areas. The operculum is thin with a well chitinized rim and the sclerite of the proximal border is complete but narrow.

The avicularia are large, the chamber about as long as the Zooecia but narrower; the mandible varies, 0.40 to 0.55 mm long by about 0.25 mm wide at the base; the main sclerites are straight and extend forward to their junction near the curved tip; the condyles are strong and partially

divide the opesia, the proximal part of which is slightly the larger. The rostrum is somewhat variable in form but is shaped like a gothic arch, slightly elevated and distinctly notched at the tip.

The peculiar spicules are abundantly developed; the curved calipers are of various sizes, ranging from 0.04 to 0.15 mm, and the wide open arms of the compasses may measure as much as 0.50 mm but are usually much smaller.

Ovicells are wanting on our material, but Busk noted them on specimens from Mazatlan, Mexico, the type locality.

Hancock Station, 545-36, Puerto Refugio, Angel de la Guardia Island, Gulf of California, one large colony covering a shell, shore collection. Also at Bahia San Francisquito, near Guaymas, Sonora, Mexico, low tide, E. Yale Dawson, collector.

Thalamoporella californica (Levinsen), 1909

Plate 12, fig. 2

Thalamoporella rozieri var. *californica,* Levinsen, 1909:184.
Steganoporella rozieri form *gothica,* Hincks, 1880:277.
Thalamoporella rozieri, Robertson, 1908:277.
Thalamoporella californica, Hastings, 1930:716.

The zoarium is at first encrusting, usually on algae, frequently rising in erect, branching, articulated form; the free branches are divided into internodes by chitinous joints. The zooecia are of moderate size, usually between 0.50 to 0.65 mm in length by 0.30 to 0.34 mm in width, the lateral walls nearly straight, the distal rim arcuate, conforming to the aperture. The perforated cryptocyst extends for half or more of the zooecial length, beyond which the imperforate roof of the polypide tube rises sharply and forms the proximal border of the opesia. The opesiules vary considerably in size and form, usually one larger than the other and the descending wall of the larger one usually extends to the dorsal wall where it forms a "shepherd's crook." The opesia is nearly round, about 0.18 mm in each dimension, arcuate but not sinuate on the proximal border; the operculum thin with a broad chitinized border, the sclerite on the proximal border strong at the sides, usually incomplete at the middle. The adoral areas are always small, frequently wanting and when tubercles are present they may be short and blunt, tall and thin, pointed or tubular.

The avicularia are nearly as long as the zooecia; at the division of a series; the mandible is elongate and varies considerably in size and form,

the average length being about 0.30 mm, its tip is usually more rounded than in *gothica*. The tip of the rostrum is complete, not notched, and encloses the tip of the mandible.

The spicules are all curved calipers; many specimens from different localities have been examined and none of the straight compasses have been observed.

The ooecia are very conspicuous, large, bilobate, and prominent, smooth or faintly striate on the surface, with a longitudinal keel; the fertile zooecia reduced somewhat in size.

While this and the preceding species resemble each other closely in general appearance, *T. californica* is smaller, has an arcuate instead of sinuate proximal opesial border, has only caliper-like spicules and lacks a notch at the tip of the avicularian rostrum. The main sclerites of the mandible are also slightly incurved instead of being straight as in *gothica*. Hincks had the species from Santa Monica, California, and Robertson listed it from San Pedro and San Diego, California; Levinsen studied Hincks' material and Hastings recorded it from the Galapagos Islands.

In the Hancock collections (24 stations) it ranges all the way from the northern Channel Islands, California, southward to Gorgona, Colombia, and the Galapagos Islands. I find no record of it from north of Point Conception, California, but it is often excessively abundant from there southward, especially in shallow water along shore, and continuing down to 47 fms. The writer has also identified it in the Pleistocene of Playa del Rey, California.

Family **Lunulariidae** Levinsen, 1909

Free, discoidal, saucer-shaped or conical zoaria; zooecia with the cryptocyst more or less developed, each zooecium preceded in the series by an auriculate vibracular chamber with a long setose vibraculum. Ovicells endozooecial or wanting.

Genus **DISCOPORELLA** d'Orbigny, 1852

The zoarium is free and discoid, convex on the frontal side, but varying indefinitely from cup to saucer-shaped, sometimes nearly flat, the dorsal side concave or flat. The zooecia are ranged in radial rows, each with a vibraculum at its distal end; cryptocyst nearly complete except for a number of opesiules on each side. The colonies resemble those of *Cupuladria* but are distinguished at once by the presence of a cryptocyst. Genotype, *Lunulites umbellata* Defrance, 1823.

Discoporella umbellata (Defrance), 1823

Plate 11, figs 7, 8, 9 and 10

The *Cupularia umbellata* of most older authors.
Cupularia canariensis, Robertson, 1908:314.
Cupularia robertsoniae Canu and Bassler, 1923:82.
Discorporella umbellata, Hastings, 1930:718.

The zoarium is usually shaped like a miniature umbrella, but is often much deeper, bowl-shaped, or even cup-shaped, or it may be a flat disc and I have seen small colonies which were actually inverted when attached on the inside of a shell. The latter habitat is rare as the larva almost without exception is attached to a sand grain or other minute object which it soon covers and extends beyond to become free, but still carries its original attachment about with it at the center of the dorsal side. The color varies from pale yellow in younger colonies to brown, the color being in the ectocyst and especially in the avicularian mandibles.

The zooecia are roughly rhombic in form and are spirally arranged; younger zooecia at the center of the colony are more elongate. The mural rim is thin and smooth; the descending cryptocyst heavy and granulated and the horizontal lamina is formed from a number of spinous processes which meet and fuse, leaving irregular opesiules on the sides; these opesiules are irregular in form and vary in number from 2 to 5, the usual arrangement being 3 or 4 on each side with a median proximal one; the distal process forms the proximal border of the aperture. At the distal end of every zooecium there is a vibraculoid avicularium, the brown mandible of which sometimes measures as much as 1 mm long.

Distributed around the world in warmer waters. Common in the West Indian region from the northern coast of South America to Beaufort, North Carolina. Recorded from the Pacific coast only by Robertson (*Cupularia canariensis*) from San Pedro and Santa Catalina Island, California, and by Hastings from Gorgona, Colombia, the Galapagos Islands and Panama. Canu and Bassler recorded it from the Pleistocene of Santa Monica, California, under the name *Cupularia robertsoniae,* but I am unable to accept this as a new species after examining over a thousand specimens from both the Pacific and Atlantic coasts. The elongated zooecia of *robertsoniae* are duplicated on the young colonies of many specimens of *umbellata,* the number of opesiules varies considerably and the size of the zoarium is merely due to age.

The range of distribution on the Pacific coast appears to be from Point Conception, California, to Point Santa Elena, Ecuador, as none were taken beyond these limits. Between these points the species is abun-

dant; represented in the Hancock collections at 151 stations from the northern Channel Islands, California, to Santa Elena Bay, Ecuador, the Galapagos Islands, Colombia, Panama, Costa Rica, Mexico, and the Gulf of California. Dredged from 5 to 100 fms, but most abundant at 20 to 40 fms.

Family **Aspidostomidae** Canu, 1908

"The zooecia have a raised margin, often indistinctly or incompletely developed. The two opesiules appear as narrow incisions which join the zooecial aperture; the short polypide tube, which is not continued under the cryptocyst cover, is in most cases provided with marginal flanges. Avicularia are always present. Ovicells are hyperstomial" (Canu and Bassler 1920:252).

The one genus here included, *Euritina,* differs from the above description in having very minute opesiules which are scarcely noticeable at the proximal corners of the opesia, and in the one species recorded no avicularia have been found. The other characters are similar to those of the family.

Genus **EURITINA** Canu, 1900

"Ovicell hyperstomial, never closed by the opercular valve; aviculariaum interzooecial; cryptocyst well developed, with three facets separated by two longitudinal grooves; no dietellae" (Canu and Bassler, 1920: 256). Genotype, *Eschara eurita* d'Orbigny, 1852.

Euritina arctica new species

Plate 29, figs. 5 and 5a

Discopora (?) *impressa,* Smitt, 1871:1126.
Not *Escharina impressa* Reuss, 1846:68.

Encrusting, unilaminar, white to brown in color. Zooecia moderately large, 0.60 to 0.70 mm long by 0.40 to 0.50 mm wide, but these limits are transcended in both directions; regularly arranged in quincunx, very distinct, irregularly ovate, the distal end rounded or ogival, the proximal end usually narrowed between adjoining zooecia. The front wall is a heavy cryptocyst with three areas, a broad rounded lateral area on each side and a central area which occupies half or more of the width and is separated on each side by a shallow groove which runs forward to the corner of the aperture; the central area slopes downward to the level of the aperture. The whole surface of the cryptocyst, even the whole margin of

the opesia, is granulated like the border. The opesia is only slightly larger than the operculum, which is free from the border at all points; semi-elliptical, widest at the proximal border which is transverse or slightly arcuate and often with a minute opesiular angle at the proximal corners. The operculum is thin with a narrow bordering sclerite, somewhat more than a semicircle, straight on its proximal border where it is attached to the frontal membrane a short distance in advance of the margin of the cryptocyst. The mural rim is continued broadly around the aperture and often bears two short stout tubular spines. There are no avicularia on our specimens and Smitt does not mention them. Dietellae are present, one large distal and several smaller lateral ones, all quite conspicuous at the edges of the zoarium.

The ovicell is hyperstomial, prominent, rounded, 0.30 mm in width, the ectooecium thick, granulated like the frontal and continuous with the frontal wall of the succeeding zooecium; it is not closed by the operculum.

Our specimens appear to agree in every detail with Smitt's illustrations (Pl. 21, figs. 17-19), though he does not mention the dietellae. His specimens were from Spitsbergen or at least north of Norway, "Fran 1868 ars Spetsberg-expedition," and I have not been able to find a more recent reference to the species.

The generic relationship of this species may be questioned because of the absence of dietellae and the somewhat longer opesia in the fossil species which have been allocated in this genus, but all of the other characters seem to conform absolutely. No other recent species is known, though Canu in his description of the genus did mention *Membranipora trifolium* var. *minor* Hincks which, however, is a synonym of *Amphiblestrum papillatum* Busk.

Type, AHF no. 49.

Point Barrow, Alaska, 18 fms on shells, G. E. MacGinitie, collector, Alaska Research Laboratory. Evidently it is an arctic species with circumpolar distribution.

Division IV **PSEUDOSTEGA** Levinsen, 1909

The cryptocyst covers most of the frontal area. There are no spines or pores; the avicularia are vicarious (replacing zooecia in the series), with usually a transverse pivot. The ooecia are embedded in the base of the succeeding zooecia and open by special pores distal to the aperture. The group is a comparatively small one, with only a few genera.

Family Cellariidae Hincks, 1880

The zoaria are erect and branched, with chitinous joints, the internodes long and rounded.

Genus CELLARIA Ellis and Solander, 1786

Genotype, *Eschara fistulosa* Linnaeus, 1758.

Key to Species of *Cellaria*

1. Avicularian mandible long-triangular. *veleronis*
 Avicularian mandible short, rounded. 2
2. Avicularium larger than a zooecium, the mandible semicircular and brown in color. *mandibulata*
 Avicularium much smaller than a zooecium, the mandible semicircular, without color. *diffusa*

Cellaria mandibulata Hincks, 1882

Plate 13, fig. 1

Cellaria mandibulata Hincks, 1882:462; 1884:203.
Cellaria mandibulata, Robertson, 1905:288.
Cellaria mandibulata, O'Donoghue, 1923:23.
Cellaria mandibulata, Canu and Bassler, 1923:86.

Zoarium erect, 25 to 75 mm in height; much branched, the branches arising at any point on an internode but usually near the distal end; the chitinous joint dark brown or black; internodes usually long.

Zooecia moderately large, 0.45 to 0.60 mm in length by about 0.20 mm in greatest width, narrowed to about 0.10 mm at the proximal end; cryptocyst flat and roughened; aperture semicircular (0.10 mm wide), the cryptocyst forming a slightly raised shelf on the proximal border. The chief distinguishing character is the very large avicularium which is broader than a zooecium, the brown semicircular mandible (0.15 to 0.20 mm in width) usually being very conspicuous.

Hincks described the species from Virago Sound, British Columbia; Robertson states that it is most common in southern California; O'Donoghue lists it for several British Columbia localities, and Canu and Bassler record it from the Pleistocene of Los Angeles, California. Recorded by Osburn (1947:18) from Hancock Station A18-39, Aruba Island in the Caribbean Sea; otherwise it has not been found outside of the Eastern Pacific area.

Hancock Stations: It is abundant and generally distributed from along shore to a depth of 80 fms all along the coast and about the islands

of southern California, where it was dredged at 69 stations. It continues to be a common form as far south as Cedros, Natividad and San Benito Islands (11 stations), but was not noted in the warmer waters south of Point San Eugenio, Lower California.

Cellaria diffusa Robertson, 1905

Plate 12, fig. 9

Cellaria diffusa Robertson, 1905:289.
Cellaria diffusa, O'Donoghue, 1923:25.
Cellularia diffusa, O'Donoghue, 1925:100; 1926:50.
Cellaria diffusa, Canu and Bassler, 1923:86.
Cellaria fissurifera Canu and Bassler, 1923:85.

Zoarium with comparatively few branches; internodes stout and usually elongate (often more than 25 mm); branching irregular, the joints brown or black.

The zooecia are rather large, 0.60 to 0.80 mm long by 0.28 mm in width, narrowed to about 0.17 mm at the proximal end; the marginal walls high, the cryptocyst flat and granulated and strongly elevated into a rounded lip on the proximal border of the aperture. Just beneath this upturned lip there is a strong, short denticle on either side on the proximal border. The avicularium is small and inconspicuous, about as wide as the proximal end of the zooecium, roughly quadrangular in form, with a semicircular colorless mandible.

The ooecium opens by a special pore distal to the aperture; the pore usually rounded with a slightly projecting proximal lip, but occasionally the pore is more or less oval or elliptical.

The *C. fissurifera* of Canu and Bassler is placed in synonymy for the following reasons: (1) the measurements are not sufficiently different to be significant; (2) the avicularia appear to be identical in size and form; (3) the adjacent mural rims are often separated by a furrow; (4) the cryptocyst is deep and flat; (5) the ooecial aperture is often elongate in *diffusa* especially in older specimens.

Robertson recorded the species from Puget Sound and from San Pedro and San Diego, California; O'Donoghue found it at several localities in British Columbia and Puget Sound; Canu and Bassler list it as *C. diffusa* and *C. fissurifera,* both from the Pleistocene of Santa Monica, California.

Hancock Stations: Rather common in the dredgings along the coast and among the islands of southern California (17 stations). Farther south it occurred at Station 182-34, off James Bay, James Island, Ga-

lapagos, 30 fms; 299, San Jose del Cabo, Lower California, Mexico, 82 fms; 2167, Dewey Channel, San Eugenio Point, Mexico, 23 fms; 2160, and 1250-41, 1 mile south of San Benito Islands, Mexico, 44 to 49 fms. The known vertical distribution is from near shore down to 118 fms.

Cellaria veleronis new species

Plate 13, fig. 2

Zoarium erect (to 25 mm in height); sparingly dichotomous, the branches curved at their proximal ends so that the bifurcations are shaped like "tuning forks"; internodes slightly sinuate, slender and elongate about 0.50 mm wide and 5 or 6 mm long), consisting of 4 to 6 series of zooecia.

The zooecia measure about 0.65 mm long by 0.30 to 0.35 mm wide, shorter and wider in the fertile zooecia; cryptocyst deep, flat in the middle area but on either side of this is a curved ridge which extends forward to opposite the aperture. The front is smooth or nearly so and shining. The aperture is semi-circular, with a raised proximal lip of the cryptocyst and a pair of strong proximal denticles. The avicularium is about as large as a zooecium; the rostrum broadly triangular at the base but somewhat elongate and attenuate distally, the thin edges raised to form a groove; at the proximal end these edges turn inward at right angles to form the hinge denticles, but leave a distinct sinus between them. The mandible is similar in form to the rostrum, even to a proximal projection which fits into the sinus.

The fertile zone of the internode is swollen, the ooecia not conspicuous and opening by a broad lunate aperture on the front.

The avicularium in this species appears to be the exact counterpart of that of *C. tecta* Harmer (1926:340), but the ooecium is different, the zooecial front is not granulated and it is a smaller and more slender species (the internodes of *tecta* measure 0.80 mm wide by 13 mm long).

Named for Captain Allan Hancock's yacht "Velero III" in which the collecting expeditions were made.

Type, AHF no. 29.

Type locality, Hancock Station 155-34, Albemarle Island, Galapagos, 0°16′45″S, 91°22′52″W, 50-60 fms. Also taken at Stations 142-34, off Clipperton Island, 65 fms; 310-35, off Bindloe Island, Galapagos, 15 fms; 788-38, SE of Daphne Major Island, Galapagos, 55 fms; 795-38, Sulivan Bay, James Island, Galapagos, 50-60 fms.

Division V CELLULARINA Smitt, 1867

The zoarium is erect, flexible or jointed and attached by radicles (loosely encrusting in a few cases); zooecia not heavily calcified, as a rule, and all facing in the same direction (except in Farciminariidae where they form rounded stems); avicularia sessile or pedunculate (both in the Epistomiidae), sometimes modified into vibracula; spines occur in most of the species, sometimes modified into frontal scutes above the opesia. Ovicells usually hyperstomial.

Key to Families

1. Avicularia pedicellate on a jointed stalk. 2
 Only sessile avicularia present. 3
2. Stalked avicularia only; ovicells hyperstomial. . . Bicellariellidae p.151
 Avicularia of two kinds, stalked and sessile; no ovicells, reproduction by slightly enlarged gonozooecia. . . . Epistomiidae p.150
3. Zooecia in 4 or 6 series around a central axis; avicularia usually paired on the gymnocyst. Farciminariidae p.119
 Zooecia usually biserial, all facing the same way, usually with a scutum. Ooecia hyperstomial or endozooecial. .Scrupocellariidae p.120

Family Farciminariidae Busk, 1852

Zoaria erect, dichotomously branched, the zooecia arranged in longitudinal rows (generally 4 to 6) around an axis formed by the separating walls; uniporous septulae; avicularia frontal (dependent), ovicells endozooecial. (After Levinsen. 1909).

Genus NELLIA Busk, 1852

The zoarium is erect, four-sided, jointed at the bifurcations. The zooecia are arranged in alternate pairs, the two of each pair opening in opposite directions; spines wanting; a pair of avicularia on the basal gymnocyst; ooecia endozooecial and small but moderately conspicuous. Genotype, *Nellia oculata* Busk, 1852.

Nellia oculata Busk, 1852

Plate 13, fig. 4

Nellia oculata Busk, 1852:18.
Nellia oculata, Harmer, 1926:240.
Nellia oculata, Canu and Bassler, 1928:26.
Nellia oculata, Osburn, 1940:400.

The zooecia are elongate, varying considerably, from 0.45 to 0.60 mm in length; in width they are fairly constant, about 0.18 mm, and main-

tain the same width for most of their length. The opesia is long elliptical, the mural rim thin and slightly raised; there is a narrow cryptocyst proximally and laterally. The avicularia are oval, small and inconspicuous, scarcely raised, one on each side of the proximal gymnocyst a little in advance of the terminal rim of the preceding zooecium. The ovicell is small (width 0.14 mm), short and cap-shaped.

Widely distributed around the world in warmer waters; common in the West Indian region, Smitt 1873:3; Levinsen 1909:120 (*N. tenella*); Osburn 1914:191 and 1940:400, and Canu and Bassler 1928:26. It has not hitherto been reported from the Pacific coast of America.

Hancock Station 500, La Plata Island, Ecuador, 20 fms, several portions of a very characteristic colony.

Nellia tenuis Harmer, 1926

Plate 13, fig. 3

Nellia tenuis Harmer, 1926:245.

Nellia tenuis, Osburn, 1940:400.

Zoarial habit characteristic of the genus, erect jointed stems arising from creeping stolons; internodes shorter than in *N. oculata* and increasing in breadth gradually from the very narrow base. Zooecia comparatively short and wide (length 0.45 mm); opesia somewhat ovate, the cryptocyst well developed proximally and narrower laterally. The most striking feature is found in the avicularian chambers which are long, extending backward in a slight curve to embrace the distal end of the preceding zooecium; the rostrum elevated and hooked and the triangular mandible decurved at the tip.

The ovicell is larger (0.16 mm broad) and more complete than in *oculata.*

Recorded by Harmer for Paternoster Islands, Borneo, Mindanao and the China Sea. Osburn reported it from Porto Rico. It has not hitherto been known from the Pacific coast of the Americas.

Hancock Station 114-33, Bahia Honda, Panama, shallow water, several colonies.

Family **Scrupocellariidae** Levinsen, 1909

Of the eight genera commonly associated with this family, four fall within the scope of the present work. The zoarium is erect or more or less spreading, usually jointed at the bifurcations; the zooecia in two or more series and all facing in the same direction; frontal and lateral avicularia are usually present; dorsal vibracula or avicularia are present

on all of our genera except *Tricellaria*; spines are usually present at the distal end, and a scutum (modified spine) usually protects the opesial area.

Key to Genera

1. No dorsal vibracula or avicularia. *Tricellaria* 121
 Dorsal vibracula or avicularia present. 2
2. Zoarium regularly provided with chitinous joints at a bifurcation, rarely a joint may be wanting. *Scrupocellaria* 130
 Zoarium not regularly jointed, occasionally a joint may appear. . 3
3. Zoarium biserial (occasionally triserial near the end of an internode); radicles forming a single bundle in the middle of the dorsal side. *Caberea* 129
 Zoarium multiserial (usually, but see *A. biseriata,* new species), radicles forming two marginal bundles and leaving the median dorsal area free. *Amastigia* 126

Genus **TRICELLARIA** Fleming, 1828

This is *Menipea,* in part, of numerous authors, but is now separated from that genus because of the difference in the manner of branching. In *Tricellaria* the joint crosses the base of a branch far proximal to the opesia of both outer and inner zooecia, while in *Menipea* the opesia of the inner zooecium is traversed by the joint, and there is no scutum. (See Harmer, 1923.)

The zoarium is erect and spreading, much branched, the internodes typically consisting of 3 zooecia, but the distal branches especially often have a larger number. The zooecia are usually much narrowed below the opesia. There are no dorsal vibracula or avicularia and the radicles are on the frontal side. The ovicells are hyperstomial. Genotype, *Cellaria ternata* Ellis and Solander, 1786.

Key to Species of *Tricellaria*

1. Internodes usually with 3 ooecia. 2
 Internodes longer, usually 5 or more zooecia. 5
2. Scutum attached well below the middle of the opesia. 3
 Scutum attached at middle of opesia or above. 4
3. Scutum narrow, simple or with 1 to 3 points. . . . *occidentalis*
 Scutum broader, 3 to 5 points. var. *catalinensis*
4. Joints light colored; usually 3 outer and one or two inner spines. *ternata*
 Joints dark colored; usually 2 outer and one inner spines. . *pribilofi*
5. Zooecia elongate at base, slender. *gracilis*
 Zooecia stouter and closely set, branches stiff. 6
6. A proximal scutum, no frontal avicularia, ovicell with a few large pores. *praescuta*
 Scutum not proximal, frontal avicularia present, ovicells imperforate. *erecta*

Tricellaria occidentalis (Trask), 1857

Plate 13, figs. 6 and 7

Menipea occidentalis Trask, 1857:113.
Menipea compacta form *triplex,* Hincks, 1882:461; 1884:208.
Menipea occidentalis, Robertson, 1905:254.
Menipea occidentalis, O'Donoghue, 1923:17.
Tricellaria occidentalis, Silen, 1941:79.

Zoarium bushy, usually not more than 25 mm in height; the branching unusually regular; internodes of 3 zooecia, though 5 or 7 may occasionally be present. The zooecia have about the same size and character as in *T. ternata,* the opesia usually a little less than half as long as the front. The scutum is diagnostic in position, as its base is attached much below the middle of the opesia; it varies greatly in form from a mere spine or simple fork (typical form) to a broadly branched structure with as many as 8 points (var. *catalinensis*). There are usually 3 outer and 3 inner spines.

Lateral avicularia large, the triangular mandible and the rostrum both hooked at the tip; frontal avicularia wanting.

The ooecia are globular and prominent, with a number of small pores.

Trask listed the species from Cape Flattery, Washington, to Santa Barbara, California. Robertson records it as far south as San Diego, California, and Hincks and O'Donoghue from British Columbia.

Hancock Station 287-34, South Bay, Cedros Island, Lower California, 10 to 15 fms, is the most southerly station. It occurs abundantly along the shores and around the islands of southern California and northward to British Columbia.

Tricellaria occidentalis catalinensis (Robertson), 1905

Plate 13, figs. 8 and 9

Menipea occidentalis catalinensis Robertson, 1905:255.

This appears to be merely a nominal variety, as suggested by Silen (1941:80). Every character mentioned by Robertson appears to intergrade; the number of zooecia in an internode is not constant, the form of the scutum ranges all the way from a curved spine to as many as 8 points and the forked spines are not constant.

O'Donoghue found that northern specimens of *occidentalis* varied toward *catalinensis.* Okada (1929:15) found the same variation in Japanese specimens.

The name *catalinensis* may be retained as a nominal variety to include the forms with a more highly branched scutum, which appears to be more constant in warmer waters. The larger scutes are dominant in southern California, but occur less frequently north of Point Conception.

Tricellaria ternata (Solander), 1786

Plate 14, figs. 1 and 2

Menipea ternata, Hincks, 1882:3.
Menipea ternata, Robertson, 1900:316; 1905:251.
Menipea ternata, O'Donoghue, 1923:17; 1926:42.

Erect and more or less spreading colonies, usually less than 25 mm in height. The internodes, especially near the base of the colony, consist of 3 zooecia, but farther out on the branches there are often as many as 5 or 7; the joints cross the narrow bases of both outer and inner zooecia at some distance proximal to the opesia.

The zooecia measure about 0.40 mm in length; they are slender and much narrowed proximally; the opesia occupies usually less than half of the frontal length; the scutum varies from a mere spine to a curved spatulate form, which may end in 2 or 3 points; the stalk of the scutum is attached well above the middle of the opesia and curves slightly downward; spines are 2 or 3 outer and 1 or 2 inner, sometimes quite elongate. Frontal avicularia usually present only on the axial zooecium below a bifurcation, small, and slightly elevated. The lateral avicularia are much larger, present on nearly all of the zooecia.

The ovicells are globose, prominent, smooth and without pores.

This is an abundant species in the cooler waters on both sides of the North Atlantic (from southern New England northward to the Arctic region), and has been listed on the Pacific coast from British Columbia southward to Lands End, California, by Hincks, Robertson and O'Donoghue.

Hancock Station 1283-41, South Point, Santa Rosa Island, California, 23 to 28 fms, is the most southerly record. It does not appear to be a common species along the California coast but occurs rather regularly from Oregon northward to southern Alaska.

Tricellaria gracilis (Smitt), 1867

Plate 14, figs. 3 and 4

Menipea ternata, Hincks, 1884:3.
Menipea ternata gracilis, Robertson, 1900:317.
Menipea gracilis, Robertson, 1905: 253.
Menipea gracilis, O'Donoghue, 1923:17; 1926:42.

Zoarium more diffuse than in *ternata,* with longer internodes. Zooecia often very elongate, occasionally as much as 1 mm, though within the same colony there may be internodes with zooecia not more than 0.40 to 0.50 mm in length, in any case the length is due chiefly to the extension of the preopesial region. The opesia is elliptical, its rim slightly raised and the cryptocyst well developed. The scutum varies greatly, from a mere curved spine to broadly spatulate, and often it is wanting; the same is true of the spines, two, one or none on the outer angle and one or none on the inner corner. Small lateral avicularia are quite constant, but the frontal ones occur only rarely near the end of an internode. The ovicell is subglobose, not so much elongated as in *M. ternata,* the surface lightly striated longitudinally.

The difference between *gracilis* and *ternata,* which have often been confused, are as follows in the Pacific coast specimens: in *gracilis* the zooecia are much more elongate and less robust; the internodes are longer with a larger number of zooecia, though *ternata* is not limited to three; the lateral avicularia are noticeably smaller, and the ovicell is somewhat shorter and slightly striated. They do not seem to intergrade, though admittedly they are closely related.

Hincks' record of *M. ternata* for "Cumshewa Harbor," British Columbia, is for the "form with many cells in an internode," and in the synonymy he gives *"Menipea gracilis."* Robertson separates *gracilis* and records it from Prince William Sound. O'Donoghue also considers it distinct and records it from several localities in British Columbia waters.

Off Hallo Bay, Alaska, 28-40 fms, Station 139-40, and Icy Straits, east end of Pleasant Island, 32-35 fms, Station C.5-41, U. S. Alaska Crab Investigation.

Tricellaria pribilofi (Robertson), 1905

Menipea pribilofi Robertson, 1905:257.
Menipea pribilofi, O'Donoghue, 1923:18.

Internodes consisting of 3 zooecia except the ooecial internodes which usually consist of 5; joints dark colored. Zooecia relatively short and stout, broad at the top, attenuated below, aperture occupying less than

half of the front surface, with 3 spines on its upper margin. Scutum simple, often a mere spinous process, sometimes broadened at the extremity; spines and scuta distinctly jointed. Frontal avicularia few and only on the axial zooecia below a bifurcation, large, raised, the beak oblique or transverse. Lateral avicularia usually present, large. Ooecia globose, smooth. (After Robertson.)

Described by Robertson from the Pribilof Islands, Bering Sea (Kincaid collection), and recorded also from Homer, Unalaska, and Yakutat, Alaska. O'Donoghue reported it as far south as Ucluelet, British Columbia. Not taken in the Hancock dredgings.

Tricellaria praescuta new species

Plate 14, figs. 5 and 6

Zoarium erect, dichotomous, branches stiff and not incurved; internodes of 3 to 15 zooecia, the basal ones short; joint crossing bases of both zooecia far below the opesia; radicles developed only on the more basal internodes.

Zooecia closely set and uniform; axis of the branch a straight line; zooecial length 0.40 mm (basal zooecia of a branch about 0.55 mm), and the width of a branch also about 0.40 mm. The ovate opesia occupies about half of the zooecial length, the mural rim narrow and little raised. The arrangement of the spines is unusual (1) a broad scutum with a stout pedicel, attached at the inner side on the proximal border, extends diagonally upward to cover most of the proximal third of the opesia (sometimes narrower but always stout); (2) at about the middle of the opesia on each side there is a stout, hollow spine which is somewhat scutiform (i.e., broader above its base) which curves upward and partially across the opesia, extending often beyond the aperture, occasionally these spines are bifurcate at the tip; (3) a short, stout, hollow spine at each distal angle (often an additional smaller spine on the outer angle) directed forward. There are no frontal avicularia. Moderately large, elevated marginal avicularia abundant, the rostrum and the triangular mandible both hooked. The axial zooecia bear scuta and spines similar to the others, with the addition of a short median terminal spine.

Ooecia are present on all of the zooecia except on the bases of the internodes and the axial zooecia; prominent but a little flattened on the front, which bears irregularly radiating lines and a few conspicuous pores; about 0.20 mm broad and extending to the opesia of the succeeding zooecium.

There is a general resemblance to *T. (Menipea) erecta* Robertson, but in *erecta* the ovicells are imperforate and the sculpturing is different,

there is no proximal scutum, and there are numerous frontal avicularia.

Type, AHF no. 30.

Type locality, Scorpion Harbor, Santa Cruz Island, California, 2 to 3 fms, one well-developed colony. W. G. Hewatt, collector.

Tricellaria erecta (Robertson), 1900

Plate 14, figs. 7 and 8

Menipea erecta Robertson, 1900:317; 1905:256.

Scrupocellaria scabra, Robertson, 1900:318.

Menipea erecta O'Donoghue, 1923:18; 1925:98; 1926:42.

The form of the zoarium is that of *Scrupocellaria,* as the internodes are longer, the zooecia more closely set and the branches are broader at their bases than is usual in *Tricellaria.*

Zooecia biserial, narrowed below, aperture occupying more than half of the front; margin raised, crenulate, with one of two blunt spines at the outer angle; scutum a flattened spine which is sometimes broadened and bifid. Lateral avicularia often wanting, or feebly developed, or sometimes rather large. Frontal avicularia generally present on each zooecium. Ooecia large, globose, more or less striated and imperforate. (After Robertson.)

The basal zooecia of the branches are shorter than is usual in the genus and the joint sometimes involves the base of the opesia of the outer zooecium.

The species was described from Alaska and later reported by Robertson from Puget Sound. O'Donoghue recorded it from numerous localities in British Columbia and Puget Sound. Okada, 1933:215, also records it from the Kurile Islands, Japan.

It is an abundant species at Point Barrow, Alaska (G. E. MacGinitie, collector, Arctic Research Laboratory). It has not been found in the Hancock dredgings, nor reported south of Puget Sound.

Genus **AMASTIGIA** Busk, 1852

The zoarium is usually without joints. The frontal surface of the pluriserial branches is convex so that the marginal zooecia are faced somewhat outwardly; the dorsal surface nearly flat. The dorsal heterozooecia are avicularia, or vibraculoid avicularia, usually directed toward the midline and more or less proximally. The radicles arise on the margins and pass downward as marginal bundles. Genotype, *Amastigia nuda* Busk, 1852.

The genus has not hitherto been recorded from the Eastern Pacific region.

Amastigia rudis (Busk), 1852

Plate 16, figs. 3, 4 and 5

Caberea rudis Busk, 1852:377.
Amastigia rudis, Harmer, 1923:322; 1926:349.
Amastigia rudis, Silen, 1941:80.

Zoarium bushy, flabellate, coarse, 2 series of zooecia at the base to 8 in the terminal branches; joints wanting.

Zooecia moderate, 0.40 to 0.50 mm in length, closely set; opesia ovoid, narrowed distally; cryptocyst broad. Scutum more or less rounded, attached distal to the middle of opesia. Spines, 3 outer and 1 or 2 inner, all small.

Frontal avicularia varying in size, those on the inner rows usually small, with an acute triangular mandible oriented distally; on the outer rows there are similar small avicularia, but these are often replaced by giant avicularia which are oriented proximally; marginal avicularia wanting. The dorsal avicularia are vibraculoid in form, oriented toward the median line and proximally, the rostrum very narrow and extending nearly to the midline of the branch, the mandible long and setiform.

The ooecia are a little longer than broad, smooth and glossy, the ectooecium covers only the distal end and extends around the sides leaving a large area of the endooecium exposed.

This species is apparently common and widely distributed in the Western Pacific from Australia to Japan, but has not been reported from the Eastern Pacific region.

Hancock Stations: 1250-41, 1 mile south of San Benito Islands, Mexico, 44 to 49 fms; 1245-41, 4 miles north of Todos Santos Island, Mexico, 41 fms; 1187-40, off Bird Rock, Santa Catalina Island, 31 to 40 fms; 874-38 northeast of Anacapa Island, 45 fms; 1269-41, 1 mile west northwest of Anacapa Island, 41 to 43 fms; 1281-41, 3 miles east of South Point, Santa Rosa Island, California, 23 to 26 fms; 116-33, Cocos Bay, Costa Rica, 2 fms.

Amastigia biseriata new species

Plate 15, figs. 1, 2 and 3

Zoarium erect, white, flexible, entirely without joints, dichotomously branched and the branches little divergent; biserial throughout the colony except for the axial zooecium, which is excluded from the dorsal surface, only its axial vibraculum appearing on the dorsal side; attached by radicles which run down the outer margins of the branches; the branches triangular in cross section, the dorsal side flat; the single colony 30 mm high.

Zooecia alternating in two series, except for the axial zooecium which makes three below a bifurcation; moderately large, 0.60 to 0.78 mm long, by 0.30 to 0.40 mm wide, narrowed slightly at the base; the opesia long elliptical, broadest and nearly straight across the distal end; there is a narrow gymnocyst, the mural rim is thin and high, the descending cryptocyst well developed and finely beaded; a short stout spine on the outer distal angle and occasionally a smaller one on the inner angle.

Four types of avicularia are present, frontal, lateral, dorsal and axial (dorsal): (1) the frontal avicularia, on nearly every zooecium, are situated on the inner corner of the gymnocyst, usually small with a triangular mandible but occasionally they are somewhat larger (scarcely "giant") and with a longer mandible; (2) lateral avicularia, small with a hooked triangular mandible, present on nearly all of the zooecia; (3) the dorsal avicularia (somewhat vibraculoid in appearance) are at the extreme bases of the zooecia, the chamber is short and nearly as wide as the zooecium, its mandible triangular at the base and ending in a long, fine point, 0.20 to 0.25 mm long and directed more or less transversely across the branch; the radicle chamber is at the outer side of the avicularian chamber and fused with it; (4) the axial avicularium is similar in structure to the other dorsal avicularia but is located near the distal end of the axial zooecium and its mandible is directed proximally.

The ovicell is directed in line with the zooecial axis, large, about 0.40 mm wide by 0.25 mm long, rather deeply embedded in the succeeding zooecium, thin walled and the surface decorated with fine concentric lines.

The absence of a scutum throws this interesting species into the small group with *A. antarctica* (Kluge) and *A. pateriformis* (Busk), but both of these species are multiserial, the ovicells are different, the frontal avicularia of *pateriformis* are larger and more elevated, and those of *antarctica* are paired. Neither Busk nor Kluge mentions the presence of a dorsal axial avicularium.

Type, AHF no. 31.

Type locality, Hancock Station 1422-41, east of Long Point, Catalina Island, California, 33°24′55″N, 118°13′25″W, 250 fms, one colony attached to a small pebble.

Genus CABEREA Lamouroux, 1816

The zoarium is rather coarse and usually without joints, though one or more may be present in a colony. The vibracula are large, covering a large part of the dorsal surface and exposed from the frontal view, the setae strong and elongate and minutely feathered toward the tip. The radicles pass downward along the midline of the stalk. Genotype, *Caberea dichotoma* Lamouroux, 1816.

Key to Species of *Caberea*

Without a scutum. *ellisi*
Scutum present. *boryi*

Caberea boryi (Audouin), 1826

Plate 15, figs. 4, 5 and 6

Caberia boryi, Harmer, 1926:362.
Caberea boryi, O'Donoghue, 1923:19; 1926:41.

The zoarium is small and delicate and is less flabellate than *C. ellisi.* The zooecia are comparatively small, 0.35 to 0.40 mm in length, the opesia occupying about three-fourths of the frontal length; the cryptocyst is broad, especially at the proximal end where it is shelf-like. The scutum presents a very diagnostic character, as its distal border extends straight across the opesia and unites with a prominence on the opposite side, thus forming a bar which closes off the aperture; the proximal lobe of the scutum is broadened to cover a considerable portion of the opesial area. There are two or three outer spines and one inner.

The frontal avicularia are usually small, elevated, with a triangular mandible, but among these, especially on the axillary zooecium below a bifurcation, are giant avicularia, much elevated, swollen, with a very strongly hooked rostrum. The lateral avicularia are minute.

The vibracular chamber covers only a little more than half of the dorsal side of a zooecium, but its groove extends to the midline of the branch. The seta is long and strong and the barbules extend nearly to its base.

The ooecia are rounded, smooth, imperforate, with a frontal area which is not covered by the ectooecium.

Reported by O'Donoghue at several stations in British Columbia waters. A cosmopolitan species, known from the coasts of Europe, Australia and the East Indies, Japan, Patagonia and elsewhere.

Hancock Stations, 287-34, South Bay, Cedros Island, Lower California, 10 to 15 fms; 1190-40, Anacapa Passage, southern California, 15 to 50 fms; 72, Guadalupe Island, Lower California, 17 fms. The writer also has a specimen from the Gulf of California, presented by Dr. H. R. Hill.

Caberea ellisi (Fleming), 1828

Plate 16, figs. 1 and 2

Caberea ellisi, Hincks, 1884:5.
Caberea ellisi, Robertson, 1905:263.
Caberea ellisi, O'Donoghue, 1923:19; 1925:98; 1926:41.

The zoarium is rather coarse, the branches fan-shaped, reaching an inch or more in height. The zooecia are well calcified, moderate in size (about 0.50 mm long by 0.20 mm wide), the elliptical opesia occupying about three-fourths of the frontal surface, and the scutum is entirely wanting. Spines strong, 2 or 3 outer and 1 inner.

Small frontal and lateral avicularia are present, the mandible rounded or short-triangular. The vibracular chambers are large, covering a large part of the dorsal surface, oriented diagonally and reaching nearly to the midline of the branch; the groove is long and narrow, its edges elevated; the seta is strong and elongate, usually more than 1.00 mm, and feathered toward the tip.

The ooecia are large, 0.20 to 0.25 mm broad, smooth, somewhat flattened, without pores and with an area on the frontal surface caused by the failure of the ectooecium to form a complete cover.

This species is common in the Atlantic Ocean from the British Isles northward and north of Cape Cod. On the west coast it was recorded by Hincks from Cumshewa and Vancouver Island, British Columbia; from Juneau, Alaska, by Robertson, and O'Donoghue lists it for numerous stations in British Columbia and Puget Sound. The writer has collected it along the shore at several places from Santa Monica to La Jolla, southern California.

Hancock Stations: 847-38, Anacapa Island; 1007-39, 1150-40 and 1316-41 from Santa Catalina Island; 1336-41, Cortez Bank; 1394-41 and 1397-41, Santa Rosa Island, and 1418-41, Santa Cruz Island, all off southern California. Station 2160, San Benito Island, Lower California, is the most southern record.

Genus **SCRUPOCELLARIA** van Beneden, 1845

Harmer has given such a complete diagnosis of this genus (1920: 364) that it is not necessary to mention more than a few essential points. The zoarium is biserial, with corneous joints crossing the proximal ends of the pair of zooecia on each side of a bifurcation, though occasionally the joint may be absent. The oval or elliptical opesia occupies from one-third to two-thirds of the frontal area and in most cases this is protected by a forked or oval scutum, though this is wanting in a few species. Distal spines are characteristic, in varying numbers and size. Both frontal

and lateral avicularia and dorsal vibracula are present, the avicularia occasionally much enlarged and modified (giant avicularia). Occasionally the frontal and lateral avicularia are of the same size, but more frequently either the frontal or the lateral series will be larger than the other. The ooecia are prominent, hyperstomial, and with or without pores.

The genus is remarkably well represented in the Eastern Pacific region. Genotype, *Sertularia scruposa* Linnaeus, 1758.

KEY TO SPECIES OF *Scrupocellaria*

1. Two axial vibracula. 2
 Only one axial vibraculum. 4
2. Scutum oval, without cervicorn decoration, ooecium imperforate. *harmeri*
 Scutum wanting. 3
3. Spines strong, radicle chamber proximal to vibracular chamber. *scruposa*
 Spines vestigial, radicle chamber lateral. *profundis*
4. Scutum wanting or vestigial. 5
 Scutum usually well developed. 6
5. Long curved lateral giant avicularia. *talonis*
 Very broad frontal giant avicularia. *ferox*
6. Scutum variously forked. 7
 Scutum broad, oar-shaped to broad oval. 10
7. Ovicell imperforate, giant elongate lateral avicularia. . . *varians*
 Ovicell with pores. 8
8. Vibracular chamber transverse, broader than long; outer and inner spines often bifurcate; no giant avicularia. . *panamensis*
 Frontal and sometimes lateral giant avicularia; vibracular chamber more or less triangular. 9
9. Giant frontal avicularia robust, rostrum hooked. . . *bertholetti*
 Giant frontal avicularia very elongate, mandible directed proximally. *bertholetti* var. *tenuirostris*
10. Giant lateral avicularia long and curved. *unguiculata*
 Lateral avicularia all normal in form. 11
11. Scutum small, oar-shaped; ooecia imperforate. . . . *californica*
 Scutum large, covering most of the opesia; ooecia with or without pores. 12
12. Vibracula very small; ooecia imperforate *scabra*
 Vibracula larger, groove diagonal or longitudinal, ooecium with pores. 13
13. Vibracular chamber two-thirds as long as zooecium. . . *diegensis*
 Chamber shorter, not more than half zooecial length. . . 14
14. Groove of vibracular chamber diagonal. *mexicana*
 Groove longitudinal. 15
15. Ooecial pores unusually large, zooecia 0.50 to 0.65 mm long. *macropora*
 Ooecial pores smaller; zooecia shorter. 16

16. Zooecia slender, curved, spines very long. *spinigera*
 Zooecia stout, closely set; joint across proximal half of outer zooecium. 17
17. Frontal avicularia all small, somewhat elevated, mandible triangular; scutum with retrorse points at the basal corners. *regularis*
 Frontal avicularia more compressed and elevated, especially the larger one on the axial zooecium, mandible narrow; scutum with broadly wedge-shaped base. *obtecta*

Scrupocellaria pugnax. This species was accidentally omitted in the key. It works out at 5, frontal avicularia large and transverse, lateral avicularia wanting.

As additional aid in identifying the many species of *Scrupocellaria* the following grouping according to certain characters will be found useful.

Two axial vibracula: *S. harmeri* Osburn, *S. profundis* n. sp., *S. scruposa* (L.).

Vibracular groove more or less transverse: *S. bertholetti* (Audouin), *S. b. tenuirostris* n. var., *S. scabra* (van Beneden), *S. varians* Hincks, *S. panamensis* n. sp., *S. talonis,* n. sp.

Giant frontal avicularia: *S. bertholetti* (Audouin), *S. b. tenuirostris* n. var., *S. ferox* Busk, *S. pugnax* n. sp.

Giant lateral avicularia: *S. bertholetti* (Audouin), *S. unguiculata* n. sp., *S. varians* Hincks, *S. talonis* n. sp., *S. californica* Trask (but normal in form).

Scutum forked: *S. bertholetti* (Audouin), *S. panamensis* n. sp., *S. varians* Hincks, *S. b. tenuirostris* n. var.

Scutum oval, without cervicorn decorations: *S. californica* Trask, *S. diegensis* Robertson, *S. harmeri* Osburn.

Scutum wanting: *S. ferox* Busk, *S. profundis* n. sp., *S. scruposa* (L), *S. pugnax* n. sp., *S. talonis* n. sp. (or vestigial).

Ovicell imperforate: *S. californica* Trask, *S. harmeri* n. sp., *S. scabra* (van Beneden), *S. scruposa* (L.), *S. varians* Hincks.

Even with this additional grouping of characters identification is not always easy because of variation. Giant avicularia may be a dominant feature, or they may be comparatively rare in the same species. The shape and size of the scutum and the number and size of the spines are subject to much variation. Ovicells are wanting in colonies that have not reached reproduction. The vibracular chamber appears to vary less than other structures.

Scrupocellaria bertholetti (Audouin), 1826

Plate 15, figs. 7 and 8, and 21, fig. 8

Scrupocellaria bertholetti, Hastings, 1930:733.
Scrupocellaria bertholetti, Osburn, 1940:386.

Zoarium erect, branching, of moderate size. Zooecia somewhat elongate (0.40 to 0.45 mm long by 0.15 to 0.18 mm in width), a little narrowed proximal to the opesia which occupies somewhat more than half of the front. The spines vary greatly in number and length; usually there are three outer (occasionally 4 or only 2), and 1 or 2 inner, outermost and inner spines rarely briefly furcate. Usually there is a small inner spine a short distance above the attachment of the scutum. The scutum also varies from a single spine curving over the opesia to a triple-forked structure with 6 or more sharp points. Frontal avicularia are always present, either small ones with the mandible directed laterally, or giant avicularia which are elevated and directed either proximally or laterally and with strongly hooked rostrum. Occasionally these may appear lower on the internode. The lateral avicularia are small, with a triangular mandible, but here also giant avicularia may occasionally occur, having much the same structure and size as those on the front and with a strongly hooked rostrum. The vibracular chambers are small and short, somewhat triangular, with a transverse groove; the seta is small and usually less in length than a zooecium; the radicle chamber is rounded and situated at the proximal end of the vibracular chamber on the outer side.

The species is widely distributed in the Red and Mediterranean Seas, the eastern and western Atlantic and elsewhere. Hastings (1930) listed it for the Galapagos Islands.

The ooecia are subglobose, prominent, averaging 0.20 mm in width, with scattered tubular pores.

Hancock Stations: A common species dredged at 24 stations from southern California to the Galapagos Islands; intermediate localities, San Benito, Isabel and Clarion Islands off the west coast of Mexico, the Gulf of California as far north as Angel de la Guardia Island, Costa Rica, and Panama. Low tide to about 100 fms. It is common in shallow water and on the piles of docks about the harbors of southern California.

Scrupocellaria bertholetti var. **tenuirostris** new variety

Plates 18, fig. 8, and 21, fig. 6

The zoarium is erect, but rather loose and spreading, growing among hydroids, algae and other bryozoans, reaching a height of about 20 mm. Usually there are either 5 or 7 zooecia in an internode and the joint crosses the outer primary zooecium of a branch at the proximal end of the opesia, the inner zooecium below the opesia.

The zooecia are quite regular in size and form (length 0.40 mm to 0.45 mm, width 0.20 at the widest part and 0.10 at the proximal end), the outer margin nearly straight. The opesia is elliptical or slightly narrowed proximally, about three-fourths as long as the zooecial front. Spines 3 (2 to 4) outer and 1 or 2 inner, rather long and slender and jointed at the base. The scutum is attached at the middle of the opesia, branched as much as 4 times when fully developed, with as many as 16 sharp points, and covers nearly all of the opesia.

The frontal avicularia are of the "giant" type, somewhat elevated, greatly compressed, the rostrum very elongate with the sides raised to form a groove and without a recurved tip; the mandible is very long and narrow, extending beyond the rostrum and ending in a broadly curved needle-like point; length of mandible 0.25 to 0.40 mm. The rostrum is directed straight downward between the zooecial series. Usually there is only one frontal avicularium to an internode, but as many as three have been observed. The lateral avicularia are all of the normal triangular form, moderately large and present on all of the zooecia.

The vibracula occur on all of the zooecia; the chamber is small, somewhat triangular in outline, the groove nearly transverse; the seta is short, not much longer than a zooecium; the radicle chamber is on the outer side at the proximal end, the radicle (0.07 mm in diameter) with retrorse hooks.

Ooecia prominent, subglobose, about 0.20 mm long and wide, with scattered tubular pores.

This form resembles *bertholetti* in most of its characters, but when the frontal avicularia are of the extremely elongate type and the scutum is fully developed it appears to be a different species. However, there is so much recorded variation in *bertholetti,* and some variation in the avicularia and scuta of *tenuirostris* that it seems better for the present to record the latter as a well-marked variety.

The writer first observed this form at the Kerckhoff Laboratory at Corona del Mar, California, where it was abundant on the floats and piles of Newport Harbor. Later, in the Hancock collections, it was found

to be common along the coast from southern California southward to Costa Rica and Cocos Island.

Type, AHF no. 32.

Type locality, Newport Harbor, California.

Hancock Stations: 253-34, 254-34, 255-34, 799-38, off Costa Rica; 870-38, Isabel Island, Mexico; 540-36, 1045-40, 1053-40, Gulf of California; 287-34, Cedros Island, off Lower California, and various stations around Santa Catalina Island, California.

Scrupocellaria californica Trask, 1857

Plates 16, figs. 6 and 7, and 20, fig. 5

Scrupocellaria californica Trask, 1857:114.
Scrupocellaria brevisetis Hincks, 1882: 462.
Scrupocellaria californica, Robertson, 1905:259.
Scrupocellaria californica, O'Donoghue, 1923:18; 1926:40.

Zoarium erect, tufted, with numerous branches; internodes with usually 3 or 4 zooecia in a series; joint immediately proximal to the outer opesia, sometimes involving its lower border slightly.

Zooecia averaging 0.40 mm long by 0.20 mm wide, narrowed to 0.13 at the proximal end, the outer border nearly straight. Opesia elliptical, occupying half or more of the frontal length; cryptocyst moderately developed, finely granulated. Scutum small and narrow, sometimes a mere curved spine, at other times it is broadened distally (paddle-shaped), the proximal lobe only being developed; at its fullest development it covers only a small part of the opesia. Two strong outer spines, with occasionally a third smaller one, and one or two small inner spines.

The frontal avicularia are all small, located on nearly all of the zooecia. The lateral avicularia also are rather small, but these are frequently replaced, especially toward the ends of the branches, but giant avicularia of about the same form. In these giant avicularia the base may be more than half as long as a zooecium, the mandible is triangular and the rostrum is very strongly hooked.

The vibracular chamber is small, often wanting, its groove transverse; the seta short and weak, usually much less than the length of a zooecium. The radicle chamber is at the outer side of the proximal end of the vibracular chamber and about equal to it in size.

The ooecia are rounded, about 0.20 mm in width, without pores and smooth except for a trace of fine lines.

It is quite probable that the *S. brevisetis* of Hincks from Houston Stewart Channel, British Columbia, is identical with *californica,* but

Hincks did not figure it, nor was he able to observe the ovicell. Robertson lists the species from San Francisco to south of Point Conception, California. O'Donoghue records it from numerous places in British Columbia and Puget Sound.

Hancock Stations: 1250-41, San Benito Island, west coast of Lower California, the farthest south it occurred. Northward from this point it was taken at Stations 1059, 1951 and 1234 at San Miguel Island, 1191 at Cortez Bank, 1281-41 and 1283-41 at Santa Rosa Island, southern California, and 1492-42 at Cape Arago, Oregon. Since it did not occur regularly in dredge hauls, though it is common along shore, it is probably limited to rather shallow water.

Scrupocellaria diegensis Robertson, 1905

Plates 15, fig. 9, and 22, fig. 1

Scrupocellaria diegensis Robertson, 1905: 261.
Scrupocellaria diegensis, O'Donoghue, 1923:18; 1926:41.

Zoarium coarse, large (50 mm or more in height), bushy; internodes elongate, as many as 12 zooecia in a series; joint crossing the proximal part of the opesia of the outer zooecium.

The zooecia are moderately large, 0.45 to 0.55 mm long by about 0.26 mm wide, the outer margin straight. The opesia is large, oval, and occupies considerably more than half of the frontal surface, the cryptocyst broad and finely granulated. The scutum is ellipsoid in form, the proximal lobe longer, not quite covering the opesia and attached by a strong pedicel a little above the middle of the opesia; the cervicorn figure is only slightly developed. Spines, 3 outer and 2 inner, strong, and the first outer and inner spines frequently bifurcate.

The frontal avicularia are usually small, slightly raised, with a triangular mandible, but giant avicularia, more elevated, with a compressed rostrum and attenuated mandible which is strongly curved, occur especially on the axial zooecium. The lateral avicularia, on every zooecium, are small with a triangular mandible. The vibracular chamber is exceptionally large, elongate (as long as 0.30 mm), prominently exposed from the frontal view for about two-thirds of its length, its groove longitudinal; the setae are coarse and elongate, frequently more than 1.00 mm long. The radicle chamber is at the outer side of the proximal end of the avicularian chamber.

The ooecium is large, prominent, slightly broader than long, somewhat flattened and provided with numerous pores.

Recorded by Robertson from San Diego to San Francisco, California, and by O'Donoghue from a number of places in southern British Columbia.

Hancock Stations: Dredged at 11 stations among the islands off southern California; at 6 stations off the west coast of Mexico, Natividad Island, San Benito Island, Thurloe Head, Cedros Island and Tenacatita Bay; in the Gulf of California as far north as Angel de la Guardia Island (Isla Partita); rather surprisingly it occurred again at Station 885-38, Gorgona Island, Colombia. It is very abundant along the shores of southern California on floats and the piles of docks.

Scrupocellaria ferox Busk, 1852

Plates 18, fig. 11, and 19, fig. 4

Scrupocellaria ferox Busk, 1852:370.
Scrupocellaria cyclostomata, Kirkpatrick, 1890:16.
Scrupocellaria ferox, Waters, 1913:476.
Scrupocellaria ferox, Harmer, 1926:367.

The species is especially distinguished by the very large avicularium which broadens outward below the opesia and partly covers its proximal area; the rostrum is directed outward, curved and asymmetrical; the mandible very acute. The lateral avicularia are so small as to be almost vestigial. There is no scutum. Busk figured the species without distal spines, but Harmer indicated that there may be four vestigial spines; the present material shows the bases of two small spines, one outer and one inner. The vibracula are visible from the front, the groove slightly diagonal. Setae were wanting on our specimens, but Harmer states that they are much longer than the zooecium and curved at the tip. No ovicells on our material, but Harmer indicates that they are large with pores which are not tubular.

Busk had the species from the Louisiade Archipelago; Waters from Zanzibar; Kirkpatrick from the Tizard Bank, China Sea, and Harmer from numerous Siboga stations about the East Indies.

Hancock Stations: 435, Wreck Bay, Chatham Island Galapagos Islands, 22 fms. two internodes, dead; 450, Galapagos, 0°55′00″S, 90° 30′00″W, 60 fms, living; and 461, Tagus Cove, Albemarle Island, Galapagos, 80 fms. It is apparently a tropical species widely distributed in the Indian and Pacific Oceans.

Scrupocellaria harmeri Osburn, 1947

Plates 18, figs. 9 and 10, and 20, fig. 4

Scrupocellaria harmeri Osburn, 1947:20.

Zoaria loosely spreading the branches narrow, the internodes of moderate length, the joint crossing the outer zooecium just proximal to the opesia.

Zooecia slender, average length 0.40 mm, narrowed to about 0.09 mm in width at the proximal end, nearly straight but a little incurved on the outer border. Opesia decidedly less than one-half the frontal length, ovoid, slightly constricted distally, with a conspicuous cryptocyst. Scutum ovate, upper lobe small, attached well above the middle of the opesia, without an alcicorn decoration; wanting on many of the zooecia. Spines 3 (2 to 4) outer and 2 (1 to 3) inner, moderately developed.

Frontal avicularia small, with triangular mandible, wanting on most of the zooecia. Lateral avicularia large and prominent, all of one size, on all of the zooecia, rostrum and triangular mandible both hooked at the tip. Vibracular chamber elongate and slender, the groove longitudinal; seta small and weak, scarcely longer than a zooecium. Radicle chamber directly proximal to and in line with the vibracular chamber; radicles smooth. There are two prominent axial vibracula.

Ooecium somewhat elongate, 0.16 mm long by 0.13 mm wide, smooth, imperforate, with the distal end inclined toward the axis of the internode.

Pacific specimens appear to agree in every respect, though they are not in reproduction, with the type specimen from Aruba Island in the Caribbean Sea. The species is similar to *S. scruposa* (L.) in appearance but is more delicate and the presence of a scutum, the larger number of spines and the form and position of the ovicell appear sufficient to separate it.

Hancock Stations: 447, Albemarle Island, Galapagos, 32 fms; 1378-41, Santa Catalina Island, California, 2 to 3 fms; and at La Jolla, California, among algae, Dr. C. L. Hubbs, collector.

Scrupocellaria macropora new species

Plates 19, fig. 2, and 20, fig. 1

Zoarium erect, the branches more or less parallel; the internodes rather long, ranging from 3 to 9 zooecia in a series; the joint crosses the outer zooecium at the proximal end of the opesia.

The zooecia are somewhat elongate (0.50 to 0.65 mm long by 0.20 mm wide at the broadest part), narrowed somewhat below the opesia. The opesia is elliptical, scarcely narrowed proximally, about half or less as long as the frontal, the mural rim thin, slightly raised. The avicularia

are all normal in form with a triangular mandible, the lateral avicularia very small and median ones somewhat larger, slightly elevated and oriented laterally. Three spines are usually present, two (or three) outer and one inner, the first outer and inner ones sometimes sinuous and directed across above the aperture. The scutum is large, oval, covering most of the opesia, with a well-developed alcicorn area, the proximal lobe larger and the distal lobe slightly elevated above the operculum.

The vibracular chamber is small, about one-third the length of the zooecium, the groove longitudinal and somewhat on the inner side; the seta is small and about as long as the zooecia. The small radicle chamber is at the outer side of the proximal end of the vibracular chamber; radicle smooth, without hooks (diameter 0.05 mm).

The ooecium is very large and conspicuous (0.25 mm or more in length by about 0.20 mm in width), somewhat depressed and not elevated at its distal extremity; it extends to the opesia of the distal zooecium; the non-tubular pores are about twice as large as is usual in the genus.

Type, AHF no. 33.

Type locality, Hancock Station 1263-41, 1½ miles off north end of Cedros Island, Mexico, 45 to 55 fms, several branches without base. Also Station 1162-40, eleven miles south of Seal Beach, California, 82 fms, on sponge.

Scrupocellaria mexicana new species

Plates 18, figs. 1 and 2, and 21, fig. 3

Zoarium rather small and spreading; internodes of moderate length, 1 to 1.5 mm, averaging about 0.40 mm in width, joints yellow, crossing the proximal part of the opesia of the outer zooecium.

Zooecia small, short (0.26 to 0.30 mm long by 0.20 mm in width at the widest part), closely set, a little narrowed below the opesia which occupies about two-thirds of the frontal length. Opesia ellipsoid, a little narrowed proximally, the cryptocyst narrow and smooth. Scutum rounded, the basal corners slightly produced, not quite covering the opesia, alcicorn pattern well developed. Spines usually three outer and two inner, all small but the second and third outer spines somewhat enlarged; none of these are forked.

Frontal avicularia on nearly every zooecium, slightly elevated with a triangular mandible directed diagonally outward and downward. The avicularium of the axillary zooecium is of the same pattern, but somewhat higher and larger. The lateral avicularia are small and sometimes wanting. The vibracular chamber, on every zooecium, is small and not

visible from a frontal view, the groove diagonal; seta slender and as long as two or three zooecia. Radicle chamber small, situated at the outer proximal border of the avicularian chamber; radicles smooth, with a few retrorse barbs (diameter 0.03 mm). One axial vibraculum.

Ooecium flattened, very prominent, the tip elevated and extending upward and forward over the proximal one-third of the opesia above the scutum; the surface roughened by irregular lines and with small short-tubular pores.

Type, AHF no. 34.

Type locality, Acapulco, Mexico, 15 fms, Capt. Fred E. Lewis, collector. Also at Hancock Stations 270, Angel de la Guardia Island, 14 fms; 2180, Magdalena Bay, Gulf of California, 18 fms; 1281-41, Santa Rosa Island, southern California, 23 fms; and 1856-49, Santa Barbara Basin, 321 fms.

Scrupocellaria obtecta Haswell, 1880

Plates 18, fig. 7, and 21, fig. 4

Scrupocellaria obtecta Haswell, 1880:37.
Scrupocellaria obtecta, Harmer, 1926:378.

Zoarium much branched, spreading over sponges; internodes usually of 4 zooecia in a series but there may be 6 or more. The joint crosses the proximal part of the opesia of the outer zooecium, involving it to near the origin of the scutum; on the inner zooecium the joint crosses immediately proximal to the opesia and sometimes involves its lower border.

Zooecia stout and closely set, ranging from 0.30 to 0.40 mm long by 0.20 mm wide, narrowed to about 0.14 mm at the proximal end, the outer border nearly straight. The opesia is large, occupying two-thirds of the frontal length, its rim slightly raised and the cryptocyst well developed and finely granulated. The scutum, which does not conform in shape to the opesial area, is roughly triangular in outline with the corners rounded, the proximal lobe is longer, the alcicorn figure conspicuous and the stalk is strong. Spines usually 3 outer and 2 inner, the second and third outer and first inner spines are long and strong, the others much weaker, and all are jointed at a little distance above the base. There is no indication of bifurcation of any of the spines.

The frontal avicularia, wanting on many zooecia, are slightly elevated, considerably compressed, with a pointed rostrum and mandible, both of which are strongly hooked, directed laterally, those on the axial zooecia often larger and much elevated. The lateral avicularia, usually present, are small with a triangular mandible.

The vibracular chamber is elongate, nearly half as long as a zooecium, and visible from in front for half of its length; groove longitudinal; seta very long, occasionally more than 1.00 mm, but usually shorter. The radicle chamber is situated at the proximal outer border of the vibracular chamber; the radicles measure 0.03 mm in diameter and are provided with retrorse barbs throughout most of their length.

The ooecia are somewhat variable in form but are usually a little broader than long (average width 0.22 mm, length 0.20 mm), elevated at the tip and extending somewhat over the scutum of the distal zooecium, the front a little flattened and with non-tubular pores which are connected by wavy lines.

The species, described from Queensland, Australia, has been taken in the Red Sea, East Africa, Indian Ocean, the East Indies and the Island of Tahiti. It has not been previously recorded from the Eastern Pacific region and our material shows some differences, but not sufficient to warrant the erection of a new species. There are no bifurcate oral spines, while in *obtecta,* according to Harmer (l.c.) the second outer and first inner are forked; Harmer described the opesia as having "hardly any cryptocyst," which agrees very well with only the younger zooecia in our specimens, and he states that the ovicells are "rather elongate" while in our material they vary and are usually slightly broader than long. There is, however, a close agreement in the form of the zooecia, avicularia, vibracula and scutum and in the size of the opesia.

Hancock Station 557-36, off White Rock, Isla Partida, Gulf of California, 28°55′30″N, 113°05′35″W, 45 fms, several colonies.

Scrupocellaria panamensis new species

Plates 17, figs. 5 and 6, and 20, fig. 2

Zoarium somewhat recumbent, branching dichotomously, the internodes usually about 1 mm in length but occasionally as much as 2 mm, 6 or 8 zooecia in a series; the joint crossing the lower part of the opesia of the outer zooecium.

The zooecia are short and wide (0.26 to 0.30 mm long by 0.20 mm wide), a little narrowed proximal to the opesia, which occupies about two-thirds of the front. The opesia is elliptical in outline with a well developed cryptocyst which is finely granular and which is only slightly narrower distally. A broad, heavy, branched scutum covers practically all of the opesia when fully developed, with 3 to 5 main branches and these often branched twice or three times (as many as 26 points have been counted); the stalk large and attached at the middle or a little proximal to the middle of the opesia. The oral spines are usually 5 or 6

in number, 3 or 4 outer and 2 inner, the proximal outer and inner spines often bifurcate and erect.

Small triangular lateral avicularia are present on nearly all of the zooecia, behind the first outer spine. Frontal avicularia are all small, slightly elevated, proximal to the opesia, with a triangular mandible directed outward or somewhat downward; occasionally only the one just proximal to the bifurcation is present.

Vibracula are found on most of the zooecia, short but nearly as wide as the zooecium, the groove nearly transverse; setae short and weak; radicle chamber at the outer, proximal corner; radicles strong and without hooks. One axial vibraculum.

Ooecium large and prominent, its distal end elevated, definitely broader than long, covering the distal zooecium to its opesia; length 0.15 mm, width 0.18 to 0.20 mm; perforated by non-tubular pores.

This species closely resembles *S. reptans* (Linnaeus) but the joint crosses the opesia of the outer zooecium, the vibracular chamber is different; there are forked erect spines and other minor differences.

Type, AHF no. 35.

Type locality, Perlas Islands, Panama (author's collection). Also Hancock Station 850-38, off Cape San Francisco, Ecuador, 15 fms; and Station 470, one-half mile north from Black Beach, Charles Island, Galapagos, 9 fms.

Scrupocellaria profundis new species

Plates 17, fig. 7 and 21, fig. 1

Zoarium slender, the branches elongated, 3 or 4 zooecia in a series in an internode. Zooecia large and elongate (0.70 to 0.80 mm long by 0.25 mm at the widest part), narrowed below the opening to about 0.15 mm at the narrowest part. Opesia long, oval, more than half the frontal length, the mural rim high and thin, smooth, with a slight smooth cryptocyst. Spines vestigial or wanting; no scutum. Lateral avicularia very minute, often wanting; frontal avicularia wanting except for one minute avicularium usually present at the side of the proximal end of the opesia of the axial zooecium at a bifurcation. Two axial vibracula, their grooves parallel and as long as those of the lateral ones. The lateral vibracula are small, not visible from the front, about one-fourth as long as a zooecium, the groove slightly diagonal; seta not as long as a zooecium; radicle chamber on the outer side, rounded and bulbous, radicles smooth and slender. No ooecia present.

The zooecia bear a rather close resemblance to *S. simplex* Kluge (1914:607) from the Antarctic, but Kluge's description and figure indi-

cate that the frontal avicularia are differently distributed; there are no vibracula, but occasional radicle chambers occur in the usual position, and joints are usually absent. In *profundis* the joints are normally developed, the dorsal vibracula regularly present and the axial ones twined.

Type, AHF no. 36.

Type locality, Albatross Expedition to Lower California, 1911, Station 5682, off San Lucas Bay, Lower California, 22°48′20″N, 109°52′40″W, 491 fms.

Scrupocellaria pugnax new species

Plates 17, fig. 4, and 21, fig. 5

Zoarium erect with slender branches, the joint involving the proximal border of the opesia of the outer zooecium, internodes with 4 to 7 zooecia in a series.

The zooecia are slender, about 0.50 mm long by 0.14 mm wide and narrowed to about 0.08 mm at the base, the outer border nearly straight. The opesia is regularly elliptical, 0.18 mm long by 0.10 mm wide, the cryptocyst finely granulated. The spines are well developed, 2 or 3 outer and 1 or 2 inner. Lateral avicularia appear to be entirely wanting. On every zooecium, immediately proximal to the opesia, is a large salient avicularium, the chamber somewhat bulbous, the rostrum elongated and directed forward and outward over the base of the opesia, both rostrum and mandible hooked. The avicularium resembles that of *S. ferox* Busk, but is smaller and less elevated. The vibracular chamber is large and prominent, visible for half of its length from the frontal aspect, its groove longitudinal; the seta strong and about twice the zooecial length. The radicle chamber is at the proximal-lateral side and included in the outline of the avicularian chamber; the radicles numerous, without serrations, about 0.04 mm in diameter. The axial vibraculum is similar in size and form to the lateral ones. There is no evidence of a scutum.

While the large, transverse avicularia of *S. pugnax* suggest *S. ferox* Busk, the latter species has only vestigial spines, the opesia is pointed oval in form, the radicles are serrated and the zooecia are shorter and wider.

Type, AHF no. 37.

Type locality, Hancock Station 451, Post Office Bay, Charles Island, Galapagos, at 60 fms, one colony without ovicells.

Scrupocellaria regularis Osburn, 1940

Plates 18, figs. 3 and 4, and 20, fig. 3

Scrupocellaria regularis Osburn, 1940:384; 1947:19.
Cellularia cervicornis, Smitt, 1872:14 (non Busk).

Zoarium erect with flabellate branches; the internodes long with often 10 or more zooecia in a series; the joint crosses the base of the opesia of the outer zooecium.

Zooecia rather short (0.35 to 0.40 mm), half as wide as long, and closely set, very regular in the arrangement of all structures. The opesia, which is elliptical, occupies about two-thirds of the frontal length; mural rim thin and slightly elevated, the cryptocyst narrow and finely granulated; the scutum when fully developed covers nearly all of the opesia below the aperture, with a very symmetrical alcicorn decoration, and the proximal corners are pointed; the full complement of spines is six, 4 outer and 2 inner, rather strong, and the proximal outer and inner ones are occasionally bifurcate. The frontal avicularia are of moderate size, numerous and none of them enlarged; the lateral avicularia are all small, occasionally wanting. The vibracula, on practically every zooecium, are large (more than half of the zooecial length), visible from the frontal view, the groove longitudinal, the seta sometimes as long as 4 zooecia. The radicle chamber is large, located at the outside of the proximal end of the vibracular chamber; radicle fibers strong, straw colored, occasionally with retrorse hooks.

Ooecia large, conspicuous, covering the distal zooecia beyond the proximal lip of the opesia, the tip elevated, perforations moderately large and without tubules.

Known hitherto only from the Atlantic, Gulf of Mexico, Caribbean Sea and Bermuda. Pacific specimens do not appear to differ in any respect except that the bifurcating spines are rare.

Hancock Stations: 557-36, off White Rock, Isla Partida, Gulf of California, 45 fms, several colonies; also U. S. National Museum No. 1474 (other data lacking).

Scrupocellaria scabra (van Beneden), 1848

Plates 18, fig. 5, and 22, fig. 2

Cellarina scabra van Beneden, 1848:73.
Scrupocellaria scabra, Hincks, 1880:48.

Zoarium moderately stout, biserial, internodes 3 to 7 or more zooecia in a series, joint crossing immediately proximal to the opesia of the outer zooecium or involving it slightly. Zooecia moderate in size (0.40 to 0.55 mm long); the outer edge slightly curved. The opesia occupies about

half of the frontal length, oval, the descending cryptocyst well developed; the rim is elevated, with a large oval scutum which has an alcicorn decoration and is flared upward at the distal end. There are one or two strong spines at the outer angle and usually a smaller one at the inner corner. The marginal avicularia, on all of the zooecia, are large and conspicuous; the frontal ones small and wanting on most of the zooecia. The vibracula are small and inconspicuous, wedge-shaped, transverse, set just above the avicularian chamber, the groove transverse and the rather stout flagellum shorter than the zooecial length; they are rare and may often be wanting from a whole internode.

Ooecia subglobose, somewhat flattened on the front, a smooth triangular area above the aperture from which fine lines radiate.

Miss Robertson's record (1900:318) from Kodiak, Alaska, was later (1905:256) referred to *Tricellaria (Menipea) erecta* (Robertson). In the following record the specimen conforms closely to Atlantic specimens, except for the scarcity of the frontal avicularia.

Alitak Bay, Alaska, 30 fms, U. S. Alaska Crab Investigation, Station 100-40.

Scrupocellaria scabra var. **paenulata** Norman, 1903

Plate 18, fig. 6

Scrupocellaria scabra var. *paenulata,* Nordgaard, 1918:32.
Scrupocellaria scabra var. *paenulata,* Osburn, 1932:11.

This high northern variety agrees with the typical form in most respects, but it is somewhat larger in all measurements and the scutum is greatly expanded, flared upward at its tip and extends forward above the proximal border of the ovicell. It appears to replace the typical form in high northern waters; it is the common variety about Greenland and the American Archipelago.

Point Barrow, Alaska, G. E. MacGinitie, collector, Arctic Research Laboratory, abundant.

Scrupocellaria scruposa (Linnaeus), 1758

Plates 19, fig. 1, and 21, fig. 2

Sertularia scruposa Linnaeus, 1758:815.
Scrupocellaria scruposa, Hincks, 1880:45.
Scrupocellaria scruposa, Hastings, 1930:703.

A rather stout species, the internodes of three or four zooecia in a series, the joint crossing the outer zooecia immediately proximal to the opesia.

The zooecia are rather closely set, 0.35 to 0.40 mm long, not greatly narrowed proximally; opesia elliptical, occupying about two-thirds of the front; the cryptocyst rather broad, especially proximally. There is no scutum. Two or three spines on the outer distal border. Frontal avicularia are entirely wanting and the lateral avicularia, present on all of the zooecia, are correspondingly large, with hooked rostrum and triangular mandible.

The vibracular chamber is elongate, about one-third the length of a zooecium, its groove slightly diagonal; seta not longer than a zooecium. The radicle chamber is situated at the proximal end of the vibracular chamber. Two axial vibracula.

The ovicells are small, smooth and imperforate.

This very widely distributed species had been noted once before in the Eastern Pacific region, as Hastings has recorded it from the Galapagos Islands at 5 fms.

Hancock Stations: 272-34, Tenacatita Bay, Mexico, 25 fms; 217-34 and 850-38, off Cape San Francisco, Ecuador; and a specimen in the author's collection from the "Gulf of California, W. Mexico." Also, Gulf of Panama, Galtsoff collection, on pearl oysters.

Scrupocellaria spinigera new species

Plates 19, figs. 7 and 8, and 21, fig. 7

Zoarium erect, with divergent slender branches; the internodes vary from 1.00 to 3.00 mm in length and consist of from 2 to 7 zooecia in a series; the joint crosses the outer basal zooecium immediately proximal to the opesia.

The zooecia are slender and curved (length 0.45 to 0.55 mm; breadth 0.18 at the widest part, narrowed to about 0.12 at the proximal end), the outer border evenly incurved from the tip of the lateral avicularium to the proximal end. The opesia is ellipsoid, length 0.18 to 0.20 mm, sometimes slightly narrowed proximally; the cryptocyst well developed on older zooecia and finely granulated. The scutum is oval with a double cervicorn figure, nearly covering the opesia, attached a little distal to the middle of the opesia, the lower lobe longer, the upper lobe slightly elevated at the tip. The spines usually are 4 outer and 2 inner, all elongate and slender; the first outer spine is the smallest and curved inward; the second and third outer and the first inner spine are very elongate (as much as 1.00 mm in length) and spread outward and curve forward somewhat like the fingers of a slightly closed hand.

Frontal avicularia all of moderate size, short pedunculate, with triangular mandible directed laterally; they are situated opposite the base

of the scutum of the adjoining zooecium and occur on practically all of the zooecia. The lateral avicularia also occur on every zooecium, small but prominent with triangular mandible. There are no giant avicularia. The vibracular chamber is elongate, one-third or more the length of a zooecium and visible from in front for about half of its length; groove longitudinal; the setae are strong and very elongate (as long as 1.80 mm, but usually shorter). The radicle chamber is situated laterally between the base of the vibraculum and the lateral avicularium; radicle 0.04 mm in diameter, with numerous strong retrorse barbs near the distal end.

Ooecium prominent (length 0.20 by width 0.18 mm) with a few small, short-tubular pores which are connected by wavy lines.

This species resembles *S. pusilla* (Smitt) of the Atlantic in the form of the zooecia and the exsertion of the vibracular chamber, but it is much larger in all of its measurements and has a full quota of frontal avicularia, none of which are enlarged or otherwise modified.

Type, AHF no. 38.

Type locality, Hancock Station 1340-41, Tanner Bank, off San Diego, California, 32°41′00″N, 119°06′30″W, 38 fms.

Also at Stations: 1112-40, San Gabriel Bay, Espiritu Santo Island, Gulf of California, shore; 1247-41, Ranger Bank, off Cedros Island, Mexico, 77 fms; 1150-40, Avalon Bay, Santa Catalina Island, southern California, 98 to 116 fms; 1896-49, middle of Tanner Bank, 22 fms.

Scrupocellaria talonis new species

Plates 17, fig. 3; 19, fig. 3, and 20, fig. 7

Zoarium erect, internodes of moderate length (1 to 2 mm), with 4 to 6 pairs of zooecia, the joint proximal to the opesia on both outer and inner zooecia of the branches.

Zooecia about 0.40 mm long by 0.20 mm wide at the widest part, narrowed to 0.13 mm or even less near the proximal end, the distal end rounded and without angulation. Opesia elliptical, large, occupying a little more than one-half of the frontal length; cryptocyst moderately developed, finely granulated. Spines small, weak, one outer and one inner, often wanting. The scutum is a small spine, occasionally slightly notched at the tip, curving over the opesia, attached somewhat above the middle of the opesial border, often wanting.

Frontal avicularia small, usually one on the axial zooecium below a bifurcation in the midline, the mandible triangular and directed laterally; rarely another avicularium down on the internode. The marginal avicularia are of two kinds, normal and giant. The normal triangular ones are moderate in size and occur on most of the zooecia; the giant avicu-

laria, which occasionally replace the normal ones, have a long, curved, talon-like rostrum 0.25 to 0.30 mm in length and both the rostrum and mandible are recurved at the tip.

The vibracular chamber is small and short, its distal end truncate, its groove transverse; the seta weak and not much longer than a zooecium; the radicle chamber is rounded and about as large as the vibracular chamber; the outer border of the double chamber is strongly sinuate. The radicles are smooth.

The form of the zooecia and the giant avicularia resemble *S. unguiculata* new species, from the Galapagos Islands, but *S. talonis* is much smaller, the scutum is vestigial or wanting, the spines very weak and the vibracular groove is transverse.

Type, AHF no. 39.

Type locality, Perlas Islands, Panama. (No other data.) Author's collection.

Scrupocellaria unguiculata new species

Plates 17, figs. 1 and 2, and 19, fig. 6

Zoarium rather large and coarse, the internodes elongate (1.00 to 4.50 mm in length) and broad (0.40 to 0.50 mm), straight and little divergent. Joints broad, immediately proximal to the opesia of the outer zooecium.

Zooecia large (0.50 to 0.60 mm long by 0.26 mm wide at the broadest part); the elliptical opesia occupying about half of the frontal length and the zooecium considerably narrowed proximally (about 0.15 mm). The descending cryptocyst is well developed and finely granular. Three long and very strong spines, jointed at the base, are present, two outer and one inner and the one on the outer angle is the smallest. The scutum is very broad, covering practically all of the opesial area, evenly rounded at both ends, attached slightly distal to the middle of the opesia by a very strong peduncle, and its alcicorn cavity is highly developed.

The frontal avicularia are infrequent, small, pointed and directed more or less laterally. The lateral avicularia are of two types. The normal ones are situated between the outer and distal spines, moderate in size, with hooked rostrum and triangular, hooked mandible. Giant avicularia are also present, scattered over the zoarium, sometimes several to an internode and sometimes wanting. This type has a very long, curved, talon-like rostrum or beak, strongly decurved at the tip, and the mandible is narrow or ligulate with a curved tip.

The vibracular chamber is short, about one-fourth as long as a zooecium, somewhat triangular in form, the radicle chamber at its outer

proximal corner and the short diagonal groove on the inner side. The seta is weak and not longer than two zooecia. There is a single axial vibraculum, of the same size and general form as the lateral ones, but more rounded proximally.

The ooecium is large, extending to the opesia of the distal zooecium, usually somewhat longer than wide, with a regular row of rather large pores around the base and a number of smaller ones scattered over the upper surface. These are connected by radiating lines and are not tubular.

Type, AHF no. 40.

Type locality, Station 795-38, Sulivan Bay, James Island, Galapagos Islands, 0°16′12″S, 90°34′50″W, 36 to 40 fms, one colony about 25 mm in height. Also taken at Sta. 450, Galapagos, 0°55′00″S, 90°30′00″W, 60 fms, and 451, Post Office Bay, Charles Island, Galapagos, 100 fms.

Scrupocellaria varians Hincks, 1882

Plates 19, fig. 5, and 20, fig. 6

Scrupocellaria varians Hincks, 1882:461.

Scrupocellaria varians, Robertson, 1905:260.

Scrupocellaria varians, O'Donoghue, 1923:18; 1926:41; 1925a:98.

Zoarium much branched and bushy, seldom as much as 20 mm in height; the internodes consisting of from 3 to 6 zooecia in a series; the joint crosses the outer zooecium proximal to the opesia.

Zooecia comparatively long and slender, 0.35 to 0.55 mm by 0.18 to 0.20 mm, narrowed to about 0.13 mm at the proximal end, the outer margin nearly straight. The long ovate opesia occupies about half of the frontal length, the cryptocyst moderately developed. The scutum is small and quite variable; usually it is three-pronged, but it ranges all the way from a simple curved spine to six points; it covers only a small portion of the opesia. There are two or three small outer and one inner spines.

Frontal avicularia are present on most of the zooecia, just proximal to the opesia, somewhat elevated, with a triangular mandible which is oriented laterally. The lateral avicularia are of two kinds, the usual form with a triangular mandible; and giant avicularia 0.30 to 0.40 mm in length, with a trough-like rostrum which varies in the form of the tip from rounded to three-pointed; mandible with a strongly hooked tip. Hincks' description indicates that the giant avicularia are "much the more abundant," but there is great variation and in some of our specimens the giant form is comparatively rare.

The vibracular chamber is very short, somewhat triangular in form, not visible from a frontal view; the groove is transverse and the seta weak and usually not longer than a zooecium. The radicle chamber is

located on the outer side at the proximal end of the vibracular chamber; radicles smooth, with a few small barbs at the distal extremities.

Ovicells 0.18 to 0.20 mm wide, broader than long, smooth, with a few irregular surface lines and without pores.

Hincks described the species from "Cumshewa Harbor," British Columbia. Robertson recorded it from Puget Sound to La Jolla, California, more abundant northward, and O'Donoghue found it at numerous localities in British Columbia.

Hancock Station: Numerous stations from Oregon south to San Diego, California. It is most abundant in shallow water but was dredged at Station 1228-41, off San Pedro, southern California, 126 to 138 fms. The only record south of California is Station 557-36, off White Rock, Isla Partida, Gulf of California, 28°55′30″N, 113°05′35″W, 45 fms.

Scrupocellaria inarmata O'Donoghue, 1926

Scrupocellaria inermis O'Donoghue, 1923:18, preoccupied by *S. inermis* Norman, 1868, and changed to *inarmata* by O'Donoghue, 1926:41.

This species, described from Trincomali Channel, British Columbia, is similar to *S. varians* Hincks, as indicated by O'Donoghue. The differences as pointed out by O'Donoghue are as follows:

Smaller than *varians;* absence of spines; absence of scutum; absence of frontal avicularia on the lower zooecia of an internode, and the lateral avicularia are all small. However, it agrees with *varians* in the characters of the vibracula and ovicells and may be merely a well-marked variety of that species. It has not appeared in the Hancock collections.

Family **Epistomiidae** Gregory, 1903

Genus **SYNNOTUM** Pieper, 1881

Zooecia in pairs back to back, each pair connected by tubular prolongations with the second pair below it. There are sessile lateral avicularia at the distal ends and frequently a stalked avicularium between the two zooecia at or near the distal end. No ovicells, but slightly expanded gonozooecia. Genotype, *Loricaria aegyptiaca* Audouin, 1826.

Synnotum aegyptiacum (Audouin), 1826

Plate 13, fig. 5

Loricaria aegyptiaca Audouin, 1826:243.
Synnotum aviculare, Robertson, 1906:286.

The zoarium spreads in small loose colonies among hydroids, bryozoans, algae, etc.; inconspicuous and probably frequently overlooked. The zooecia are small, about 0.40 mm long, delicate and little calcified, the area occupying nearly all of the front; attached in pairs back to back, a basal prolongation of each pair extending proximally to the second zooecium below. A small sessile avicularium at one or both distal corners, and occasionally a stalked avicularium arising distally on the dorsal side of one or both members of a pair. The stalked avicularia are short and bulbous, with a short hooked beak and very short hooked mandible. Radicle fibers also arise at the distal ends of the zooecia. No spines, no ooecia.

Distributed around the world in warmer water, usually recorded as *S. aviculare* Pieper. Robertson recorded it from off San Pedro and San Diego, California.

Hancock Stations: 881-38 and 1281-41, Santa Rosa Island, and 1219-40, San Nicolas Island, California; 577-36, Isla Partida, and 1072-40 and 1074-40, off Rocky Point, Sonora, Mexico; 847-38, southwest of Zorritos Light, Peru. Shore to 45 fms. A rather common shorewise species along the coast of southern California.

Family **Bicellariellidae** Levinsen, 1909

The genera included in this family are usually erect, occasionally more or less recumbent or even loosely encrusting; biserial, sometimes uniserial or multiserial. They are usually well chitinized and but little calcified. The zooecia take their origin from the dorsal side of the preceding zooecia in the series, so that the distal ends overlap more or less the bases of the succeeding zooecia. The opesia are usually large, frequently occupying the whole front, though the gymnocyst may be well developed in many cases. The sides of the zooecia are frequently rolled inward (turbinate). Spines, both terminal and lateral, are usually present, and pedunculate avicularia are characteristic, though both spines and avicularia may occasionally be wanting.

Various authors, notably Canu and Bassler, have separated this family into three, viz. Bicellariellidae, Bugulidae and Beaniidae, and the writer accepted this procedure in his 1940 paper, "Bryozoa of Porto Rico." Further study of the basic characters, however, leads me to the conclusion that such a separation is unwarranted, and the analysis of the

group by Harmer (1926:409) and the comments of Silen (1941:92) offer satisfactory evidence against such a wide separation of the evidently related genera.

KEY TO GENERA OF BICELLARIELLIDAE

1. Proximal end of zooecium narrow and tubular. 2
 Proximal end not narrowly tubular. 4
2. Tubular base of zooecium expanded abruptly, zoarium sprawling or repent and loosely attached. *Beania*
 Tubular base expanding gradually, zoarium erect. 3
3. Zooecium constricted into three definite regions, the terminal one expanded. *Bicellariella*
 Zooecium not differentiated into "segments." . . *Corynoporella*
4. Zoarium multiserial, erect, recumbent or encrusting; base of zooecium transverse at point of origin. 5
 Zoarium biserial to narrow multiserial, erect, base of zooecium forked or diagonal at point of origin. 6
5. Zoarium erect or recumbent, attached by radicles; a thickened dorsal area on either side of the distal zooecial wall. *Dendrobeania*
 Zoarium encrusting loosely, not attached by radicles; no thickened dorsal area; numerous proximal spines and paired avicularia on the gymnocyst. *Sessibugula*
6. Zoarium with segmented stalk, the segments are modified zooecia (kenozooecia); base of zooecium at point of origin diagonal. *Caulibugula*
 Zoarium erect and bushy, without segmented stalk; base of zooecium at point of origin strongly forked. *Bugula*

Genus **BICELLARIELLA** Levinsen, 1909

Bicellariella Levinsen, 1909:431, replacing *Bicellaria* Blainville, preoccupied.

Levinsen (1909:99), under *Bicellaria* Blainville, gives the following diagnosis of the genus: "Each zooecium consists of three sections, separated by constrictions, of which the middle one is elongated, cylindrical, while the distal one is obliquely funnel-shaped; the basal edge of the distal wall unequally asymmetrically angular; the radical fibers issue from the basal side of the zooecium." To this Harmer (1926:421) adds that the turbinate zooecia are typically provided with numerous oral and distal spines. Genotype, *Sertularia cilata* Linnaeus, 1758:815.

From the above description of the genus it becomes evident that no species of *Bicellariella* has been recorded from the Pacific coast. O'Donoghue tentatively placed two species here, but neither of them shows the zooecial constrictions and their ovicells are quite different from those of *Bicellariella*. As no opportunity has been offered to study specimens, I leave them here until more information is available.

? **Bicellariella brevispina** (O'Donoghue), 1923

Bicellaria brevispina O'Donoghue, 1923:19.
Bicellariella brevispina, O'Donoghue, 1926:43.

The zooecia are very slender and elongate, with the opesia extending about half the frontal length and the form is not at all turbinate in the bicellarian sense; there are no constrictions of the zooecial body; avicularia are wanting; the spines are not bicellarian, and the ooecium which is deeply embedded in the base of the succeeding zooecium is totally different. The sterile zooecia have considerable resemblance to those of certain species of *Brettia* but that genus is not known to have ovicells.

Gabriola Island, Union Bay and Bull Passage, British Columbia (O'Donoghue).

? **Bicellariella stolonifera** O'Donoghue, 1926

O'Donoghue 1926:43.

The zoarium consists of a creeping stolon from which arise the zooecial branches with a small number of zooecia. The form of the zooecium is somewhat turbinate, but the opesia occupies most of the length and there is no evidence presented of the constriction into three regions which is characteristic of *Bicellariella.* The distal spines are arranged in outer and inner groups like those of *Bugula,* but one or two proximal spines may also be present. The avicularia are lateral, half way up the side of the opesia. The ooecium is terminal instead of on the inner corner and "does not appear to be a pedunculate structure."

Cape Lazo to the San Juan Islands, British Columbia (O'Donoghue). Apparently this is not a *Bicellariella.*

Genus **BUGULA** Oken, 1815

Genotype, *Sertularia neritina* Linnaeus, 1758.

As at present understood, this genus includes a rather large series of species which are for the most part biserial, but with occasional uniserial or multiserial zoaria. The zoarium is unilaminar, with the zooecia all facing in the same direction. At the point of origin on the dorsal side, the zooecia are usually prominently forked, and the distal end of each zooecium extends above the base of the succeeding one. The opesia occupies nearly all of the frontal surface, and the side walls are somewhat reduced with mere angulation of the distal corners. The stalked avicularia are of the "birds-head" type and are often of diagnostic value. Ooecia are typically globular and attached by a short stalk at the distal end in

the median line, but a few species have them attached asymmetrically (e. g. in the type species *B. neritina*) at the inner corner, and occasionally they may be reduced to a small saucer-shaped cap. The mode of branching is also characteristic. In older colonies the lower branches are often lost and the radicles pass downward for attachment, giving the appearance of a stalk.

KEY TO THE SPECIES OF *Bugula*

1. No avicularia. Zoarium coarse and reddish-purple, conspicuous. Zooecia large, aperture extending to base; no spines but the outer corner angulated; ovicells large, set diagonally. . *neritina*
 Avicularia present. 2
2. Avicularia attached near the base of the zooecia. 3
 Avicularia attached higher up on the side. 5
3. Ovicell reduced, cap-like, in line with zooecial axis. . . . *pacifica*
 Ovicell not reduced, turned at an angle to zooecial axis. . . . 4
4. Aperture extending to zooecial base; zooecia of the two series turned slightly inward. *minima*
 Aperture about half of zooecial length; zooecia of the two series facing slightly outward. *uniserialis*
5. Avicularia slender and elongate, half the zooecial length. *longirostrata*
 Avicularia not unusually slender and elongate. 6
6. Zooecia biserial in arrangement. 7
 Zooecia in more than 2 series. 9
7. Ovicell complete, globular. *californica*
 Ovicell in the form of a hood or otherwise incomplete. 8
8. Ovicell well calcified, in the form of a hood. *cucullifera*
 Ovicell largely membranous, zoarium soft and flaccid. . . *mollis*
9. Distal end of zooecium truncate; ovicells prominent. . . *flabellata*
 Distal end of zooecium rounded, usually with a small terminal knob; no ovicells. *pugeti*

Bugula neritina (Linnaeus), 1758

Plates 23, fig. 3, and 24, fig. 3

Sertularia neritina Linnaeus, 1758:38.

Bugula neritina, Robertson, 1905:266.

Bugula neritina, Hastings, 1930:704.

The zoarium is rather coarse for a *Bugula* and often forms large tufts 100 mm or more in height. The color, when mature, is dark reddish purple. The zooecia are large, without spines except for the pointed process at the outer distal corner, and there are no avicularia. The ovicells are large, globular, attached at the inner corners of the zooecia, and they are often so plentifully developed that they seem to form a series of small beads along the branches.

This, the type species of the genus, is also the best known. It appears to be distributed everywhere in warmer waters along the shores. Along

the California coast from Monterey southward it is usually the most conspicuous bryozoan species, the dark reddish or purplish brown clusters clinging to anything that will afford attachment. It is also constant in its presence on piles of wharves and the under side of floats. Robertson records it for California from Monterey Bay southward. Hastings lists it for the Galapagos Islands and the Canal Zone.

In the Hancock collections it occurs abundantly from the Channel Islands, California, all down the Mexican coast and on to the Galapagos Islands and in the Gulf of California as far up as Angel de la Guardia Island. Although it is characteristically a shallow water species it has been dredged at a depth of 43 fms off Santa Cruz Island, California.

Bugula minima (Waters), 1909

Plates 22, fig. 8 and 23, fig. 5

Bugula neritina var. *minima* Waters, 1909:136.
Bugula neritina var. *minima,* Hastings, 1930:704.
Bugula minima, Hastings, 1939:334.
Bugula minima, Osburn, 1940:390.

Resembling *B. neritina* in its general aspects, but much smaller, lighter in color and with avicularia. It does not appear to be an abundant species, but it is distributed around the world in warmer waters; in the Red Sea, Indian Ocean, Malay and New South Wales; Osburn lists it from the Tortugas Islands, Florida, and Porto Rico, and Hastings recorded it from Gorgona, Ecuador, and the Galapagos Islands.

Hancock Station 779-38, off Nuez Island, Cocos Islands, Costa Rica, 30 to 50 fms. Also from the Gulf of Panama, Isla Santelmo, on pearl oysters (Galtsoff collection).

Bugula pacifica Robertson, 1905

Plates 22, fig. 6, and 23, fig. 4

Bugula pacifica Robertson, 1905:268.
Bugula purpurotincta, Robertson, 1900:320.
Bugula pacifica, O'Donoghue, 1923:20; 1926:45.

A northern species which Miss Robertson indicated as distributed from the Pribilof Islands, Bering Sea, to San Francisco Bay; she described it from material collected by Dr. W. E. Ritter at Orca, Prince William Sound, Alaska. O'Donoghue found it at numerous localities in British Columbia, and the writer has specimens taken by Prof. G. E. MacGinitie at Departure Bay, near Victoria, British Columbia. The species is easily recognized by the very incomplete ovicell which is barely large enough to cover the egg and not half large enough to cover the

developing larva. The avicularium attached near the base of the zooecium easily separates it from *B. longirostrata,* which also has an incomplete but somewhat larger ovicell.

Hancock Stations: 1478-42, Yaquina Bay, Oregon, 2 to 5 fms; 1480-42, mud flats, Yaquina Bay, Oregon, intertidal; 1493-42, North Beach, Cape Arago State Park, Coos Co., Oregon, intertidal; 1661-48 and 1662-48, Santa Cruz Island, southern California, 23 fms.

Bugula longirostrata Robertson, 1905

Plates 22, fig. 7, and 24, fig. 1

Bugula longirostrata Robertson, 1905:274.
Bugula longirostrata, O'Donoghue, 1923:21.

The slender, elongate avicularia, at least half as long as a zooecium, and the incomplete ovicell which is shaped like an overturned bowl, readily distinguish this species from other west coast Bugulas. Robertson recorded it from only one locality, "off La Jolla (California) at a depth of 125 fathoms," and O'Donoghue from Cape Ebenshaw, British Columbia.

The writer collected it on the piles of the Scripps Laboratory wharf at La Jolla, California. The known range of the species is from British Columbia to the Galapagos Islands at the equator, and from the shore to a depth of 125 fms. Judging by the records it would appear to occur regularly at greater depths than our other Bugulas.

Hancock Stations: 66-33, Tagus Cove, Albemarle Island, 2 to 20 fms, and 795-38, Sulivan Bay, James Island, 36 to 60 fms, Galapagos; 651-37, east of San Francisco Island, Gulf of California, 60 fms; 1259-41, south of Dewey Channel, Mexico, 49 fms; 1150-40, 1365-41 and 1407-41, Santa Catalina Island, southern California, at 21 to 116 fms.

Bugula californica Robertson, 1905

Plates 23, fig. 1, and 24, fig. 2

Bugula californica Robertson, 1905:267.
Bugula californica, O'Donoghue, 1923:20; 1926:45.
Bugula californica, Marcus, 1937:71.

The zoarium is in the form of spiral whorls as much as 50 mm high, similar to *B. turbinata* Alder of the west European coast and *B. turrita* (Desor) of the western Atlantic. The globular ovicell, attached at the middle of the distal end of the zooecium; the presence of three spines and the attachment of the avicularia at the middle of the zooecial wall easily separate it from other Pacific coast species. In addition, two sizes

of avicularia are usually present, those on the outer zooecial wall being much larger than those on inner zooecia below or just above a bifurcation, and occasionally nearly all of them are small.

Robertson records the species from Monterey Bay north to Dillon Beach, California. O'Donoghue lists it from a number of localities in British Columbia, which would appear to be the northern limit of distribution. Marcus found it in Bahia de Santos, Brazil.

Hancock Stations: 17-34, Stephens Bay, Chatham Island, Galapagos, 32 fms; 1067-40, off Consag Rock, Gulf of California, shore; 1410-41, 3 miles east of South Point, Santa Rosa Island, California, 17 to 20 fms. The writer has also collected it in Newport Harbor, California, on the piles of docks. Very abundant in Miss Blagg's collection from the vicinity of Monterey Bay, California. It appears to have a wide range along the Pacific coast, from British Columbia to the Galapagos Islands, and the record by Marcus from Brazil extends its range to the Atlantic.

Bugula flabellata (J. V. Thompson), 1847

Bugula flabellata, Robertson, 1905:270. (Not 1900:321, see *B. pugeti*).

Zoarium consisting of flabellate branches of varying width, usually 3 to 6 series of zooecia, the larger branches arising near the short base and more or less whorled. The zooecia are elongate, the membranous area occupying the whole front; the lateral margins are free from spines, but there are 2 to 4 on the distal end, the proximal ones often curved somewhat across the aperture. Avicularia on the marginal zooecia only, attached above the middle of the zooecial length, moderately large and robust with a strongly decurved beak.

Ovicell subglobose or somewhat hood-shaped, with broad, short base, directly in line with the zooecial axis.

This well-known species is definitely a *Bugula* in spite of the multiserial arrangement of the zooecia, as it lacks the special calcified dorsal walls of *Dendrobeania,* and the origin of the zooecium is long-forked, the prongs extending well down the sides of the preceding zooecium.

It is widely distributed over both shores of the Atlantic, southward to the Cape of Good Hope and Brazil, but has been recorded only once for the Pacific, where Robertson found it growing on piles in San Diego Bay, California.

Hancock Stations: 371-35 and 374-35, Viejas Island, Independencia Bay, Peru, 5 to 12 fms.

Bugula pugeti Robertson, 1905

Plate 23, figs. 7 and 8

Bugula pugeti Robertson, 1905:271.
Bugula flabellata, Robertson, 1900:321.
Bugula pugeti, O'Donoghue, 1923:21; 1925:100; 1926:45.

This multiserial species belongs to the genus *Bugula* for the same reasons given under *B. flabellata.* It differs from *flabellata* in a number of ways, the distal zooecial end is rounded instead of truncate, the spines are fewer, shorter and pointed, and the avicularia are somewhat longer, stouter, all of one size, and all on the outer zooecia. The most striking difference is in the entire absence of ovicells. As Miss Robertson pointed out, there is a small rounded knob at the middle of the distal end of most of the zooecia, but as this is lacking on the first few proximal rows of each branch it leads to the suggestion that it is the merest vestige of an ovicell.

Robertson recorded the species from Sitka, Alaska, to Puget Sound, and O'Donoghue lists it for numerous localities in British Columbia waters, low tide to 15 fms.

It did not appear in the Hancock dredgings, but there are specimens in the collection from Departure Bay and Five Fingers, British Columbia; Tomales Bay, California (R. J. Menzies), and also from San Francisco Bay, California, Albatross Station D 5770, which is the southernmost record.

Bugula mollis Harmer, 1926

Plates 22, fig. 3, and 23, fig. 6

Bugula mollis Harmer, 1926:445.
Bugula mollis, Hastings, 1930:704.

The zoarium is bushy (40 mm high in one specimen), with loosely turbinate branches, delicate and flaccid; the branches definitely jointed at the base. The zooecia are biserial, moderately large; the opesia reaches nearly to the proximal end, inclined toward the zoarial axis. Harmer (pl. 31, fig. 10) shows the species with three long distal spines, jointed at the base, but in our material these are represented by short pointed processes. The avicularia are situated on the outer rim half way or more above the base.

The ooecium is incomplete, lacking the front wall, but is circular in outline and projects forward on a pedicel. Harmer and Hastings have called attention to the differences between this species and *B. pacifica* Robertson which also has joints at the base of the branches. In addition to the lack of calcification in *mollis* and the position of the avicularia, which in *pacifica* are proximal to the opesia, it may be added that the ovicell of *mollis* is longer and more projecting while in *pacifica* it is a short

hemispherical cap set close against the distal end of the zooecium.

Described by Harmer from New Guinea and the Java Sea; recorded by Hastings from Coiba, Panama, and the Galapagos Islands.

Hancock Stations: 66-33, Tagus Cave, Albemarle Island, Galapagos, 10 to 20 fms. Also at Albatross Sta. 5771, San Francisco Bay, California, several colonies.

Bugula cucullifera Osburn, 1912

Plate 22, figs. 4 and 5

Bugula cucullifera Osburn, 1912:225.
Bugula cucullata Verrill, 1897:188 (preoccupied, Busk, 1867:241).
Bugula cucullifera, O.Donoghue, 1923:22; 1926:45.

The zoarium is erect and the branches little divergent. The zooecia are moderately elongate, narrowed gradually to the proximal end, the distal end more or less transverse; the opesia about three-fourths of the frontal length; two or three outer and one or two inner elongate spines. Avicularia large and longer than the width of a zooecium; the beak long, concave above and strongly hooked at the tip; situated about half way up the side of the opesia but varying considerably in position.

Ovicell in line with the zooecial axis, short and broad, shaped like a hood and widely open, its attachment very broad.

Verrill and Osburn recorded this species from Cape Cod, Massachusetts, northward to Labrador. O'Donoghue listed it from a number of localities on the British Columbia coast and south to Puget Sound. Not taken in the Hancock collections.

Bugula uniserialis Hincks, 1884

Bugula pedunculata O'Donoghue, 1925:17.
Bugula uniserialis, Hastings, 1930:705.

A small slender species in which the zooecia are much narrowed on the basal half and the opesia not more than half the zooecial length; the distal corners are sharply angulated but spines are wanting; the avicularia are attached at the proximal end and the peduncle is slightly longer than usual in other species. According to O'Donoghue's figure (Plate 2, fig. 3) the zooecia of the two series are turned slightly outward instead of toward each other as in most members of the genus.

Hincks described the species from West Australia. O'Donoghue redescribed it as *B. pedunculata* from La Jolla, southern California, and Hastings recorded it from two localities at Tagus Cove, Albemarle Island, Galapagos, shallow water. It has not appeared in the Hancock dredgings.

Bugula avicularia (Linnaeus), 1758

Bugula avicularia, Hincks, 1884:5.
Bugula avicularia, O'Donoghue, 1923:20.
Bugula avicularia, Hastings, 1930:703.

This species, recorded by Hincks and by O'Donoghue from several shorewise localities in British Columbia is close to *B. californica* Robertson. Both have turbinate colonies with biserial branches; the aperture occupies nearly all of the frontal length; the avicularia are situated at or beyond the middle of the zooecia, and the ovicells are similar. On the other hand, the avicularia of *californica* are shorter and more robust, with a shorter and more decurved beak, and there are usually two well-developed inner distal spines.

It is a species of northern distribution; in Europe from the Arctic to the Bay of Biscay; it has been only doubtfully recorded from the eastern coast of North America, and O'Donoghue (1925) did not find it in Puget Sound. Hastings lists it from Balboa, Canal Zone, but calls attention to certain differences. It has not appeared in the Hancock dredgings.

Genus CAULIBUGULA Verrill, 1900

Genotype, *Caulibugula armata* Verrill, 1900.

Bugulas with jointed stalks, the joints consisting of kenozooecia of varying length. The proximal zooecia of the branches usually differ more or less from distal ones. The ovicells are often incomplete and are attached near the inner corner of the zooecia and turned somewhat sidewise. The zooecia are more narrowed toward the base than in *Bugula* and the opesia is shorter, usually not more than half of the frontal area.

The species of this genus have usually been referred to *Stirparia* Goldstein, 1880, and *Stirpariella* Harmer, 1923, but Goldstein's use of the name was preoccupied by Leuckart 1841. Verrill's name *Caulibugula* was overlooked for many years and *Stirpariella* is a synonym.

Key to Species of *Caulibugula*

1. Aperture turned upward, 4 or 5 spines at the outer corner. . *ciliata*
 Aperture in line with the frontal surface, 2 or 3 spines at the outer corner. 2
2. Aperture occupying half of the frontal surface, avicularia half way up the side. *occidentalis*
 Aperture occupying three-fourths or more of the frontal surface, avicularia near base. *californica*

Caulibugula ciliata (Robertson), 1905

Plate 24, figs. 4 and 5

Stirparia ciliata Robertson, 1905:279.
Stirparia ciliata, O'Donoghue, 1923-22.
Stirparella ciliata, O'Donoghue, 1926:47.

This is a peculiar species, showing certain resemblances to *Bicellariella ciliata* (Linnaeus). The slanting, oval, opesial area, the rounded distal end without angulations, the attachment of the ovicell on the inner border of the distal part of the zooecium, all of these are found in *B. ciliata.*

On the other hand there are neither dorsal spines nor a proximal spine, and the basal zooecia of the colony as well as the proximal zooecia of the basal branches are modified into kenozooecia and form a stalk. The basal zooecia of the upper branches are not so modified. The stalk zooecia, well represented in Robertson's drawing, pl. 12, fig. 68, are only partially modified into kenozooecia and appear to have contained zooids. On the whole the resemblance is so great that the writer was once misled (Osburn 1923:7) to make the suggestion that this might be merely a variety of *B. ciliata* (Linnaeus).

Robertson had the species from a number of localities along shore on the California coast from Pacific Grove northward. O'Donoghue lists it for several British Columbia localities.

Hancock Station 1281-41, 3 miles east of South Point, Santa Rosa Island, southern California, 23 to 26 fms. Also from Dillon Beach, California (Menzies collection), and from Lands End, San Francisco Bay, California (Robertson collection).

Caulibugula occidentalis (Robertson), 1905

Plate 24, fig. 6

Stirparia occidentalis Robertson, 1905:280.
Stirparia occidentalis, O'Donoghue, 1293:22, 1925:100.
Stirpariella occidentalis, O'Donoghue, 1926:47.

This species has the segments of the stalk fully modified into kenozooecia and the first zooecium is also modified in the manner characteristic of the genus. The basal zooecium of a branch, however, is scarcely different from those distal to it.

The zooecia are elongate and curved and occasional individuals have the "joint" which is characteristic of the genus *Bicellariella.* The distal end of the zooecium is rounded, with two or three long, jointed, outer spines and one inner spine. The opesia occupies nearly half of the frontal

length. The avicularia are attached opposite the proximal end of the opesia. The hood-shaped ooecium is attached on the inner border just above the inner spine and is turned somewhat sideways.

Robertson gives its distribution as "several localities on the coast of California and Puget Sound," and O'Donoghue records it for several places in British Columbia and Puget Sound.

Hancock Stations: 1478-42, Yaquina Bay, off Yaquina, Oregon; 885-38, San Luis Obispo Bay, California, low tide to 14 fms, and 880-38, Santa Rosa Island, southern California, 16 fms.

Caulibugula californica (Robertson), 1905

Plate 24, figs. 7 and 8

Stirparia californica Robertson, 1905:281.
Stirparia californica, O'Donoghue, 1923:23.
Stirpariella californica, O'Donoghue, 1926:47.

This species belongs to the group in which the outer corner of the zooecium is strongly angulated. The angle is either continued into a short spine, or it is provided with an elongated spine, jointed at its base, and other spines are few or wanting. The stalk segments are highly modified kenozooecia, and the stalk may be as much as 50 mm long, with a palm-like cluster of branches at the top. The zooecium is not sharply narrowed proximally, the membranous area extends nearly to the base and the avicularia are basal in position. The primary zooecium of the branch does not differ from the distal ones, except that the outer corners are not angulated. In the absence of the stalked base with its highly specialized kenozooecia this species would undoubtedly be placed at once in the genus *Bugula.*

Robertson recorded the species from only one locality, "at a depth of 125 fathoms in the submerged valley of La Jolla," California. O'Donoghue recovered it at 8 localities in British Columbia, 8 to 40 fms.

Hancock Stations: 296, Agua Verde Bay, and 2186, Cabeza Ballena, Lower California, Mexico, 30 fms; 1150-40, Avalon Bay, Santa Catalina Island, southern California, 98 to 116 fms; 1479-42, Boiler Bay, north of Depoe Bay, Oregon, intertidal; 1249-41, San Benito Islands, west of Lower California; and 1249-41, Santa Cruz Island, southern California.

Genus CORYNOPORELLA Hincks, 1888

The zoarium is uniserial, slender and branched dichotomously. Zooecia all facing the same direction, more or less regular in form, elongate, the proximal half tubular, the terminal half somewhat expanded; opesia occupying about half of the zooecial length. Each individual arises from the dorsum of the preceding one near its end. Avicularia buguloid. Ooecia globose. Radicles arising on the side near the distal end. Genotype, *C. tenuis* Hincks, 1888:215.

Corynoporella spinosa Robertson, 1905

Plate 24, figs. 9 and 10

Corynoporella spinosa Robertson, 1905:284.
Corynoporella spinosa, O'Donoghue, 1922:23.

The zooecia are slender and elongate (0.50 to 0.65 mm long by about 0.20 mm wide), expanding from the narrow tubular base rather regularly to the distal end. Opesia long-ovate, narrower at the proximal end, surrounded by a slightly raised thin rim which usually bears three small terminal spines, one median and one at each corner; the cryptocyst is not evident. Avicularium (about 0.22 mm long) stout, on a very short pedicel, the point of the beak strongly decurved. Ooecia prominent, globose, with a few longitudinal striae.

The species is much like the genotype, *C. tenuis* Hincks (1888:215) from the Gulf of St. Lawrence, but the zooecia are more truncate at the distal end, spines are present and the beak of the avicularium is strongly decurved.

Robertson described the species from Alaska, "locality unknown," growing on a crab. The only other record is that of O'Donoghue, Swiftsure Shoal, British Columbia, 25 fms.

Big Koniuji Island, Alaska, Sta. 82-40, 25 to 30 fms, and off Hallo Bay, Alaska, Sta. 139-40, 28 to 40 fms, U. S. Alaska Crab Investigation.

Genus SESSIBUGULA new genus

Plate 26, figs. 1, 2 and 3

Zoarium encrusting, loosely attached, dorsal wall smooth, without radicles. Gymnocyst extensive and bearing buguloid avicularia and tubular spines; ooecium hyperstomial, buguloid; operculum wanting; septulae multiporous in the lateral and uniporous in the distal walls; calcification slight. Genotype, *S. translucens* new species.

In spite of its encrusting nature, this form definitely belongs in the *Bugula* complex. The absence of a calcified dorsal area on either side of

the distal wall is similar to *Bugula.* The ooecium is more like that of *Dendrobeania* and the close association of the zooecia in a broad layer resembles that of *D. (Bugula) laxa* (Robertson) and especially *D. (Flustra) lichenoides* (Robertson), both of which are repent. The encrusting zoarium, the very extensive gymnocyst which bears pedunculate avicularia and spines, and the absence of radicles appear to exclude it from any known genus.

Sessibugula translucens new species

Plate 26, figs. 1, 2 and 3

Zoarium loosely encrusting on smooth surfaces, forming flat colonies. Zooecia large but quite variable in size, 0.65 to 0.95 mm long by 0.30 to 0.45 mm wide, closely associated without any evidence of fenestrae, forming a smooth, thin and often almost transparent crust. The opesia is irregularly ovate or elliptical with a raised margin, occupying about the distal half of the front. The walls are very thin, the lateral walls scarcely separable. The gymnocyst is extensive, occupying the proximal half of the front and is quite transparent; bearing spines and stalked avicularia. The cryptocyst is barely traceable as a minutely beaded border.

Spines: a tall tubular spine on each side toward the distal end, bending slightly across the opesia; 1 or 2 erect spines on the sides, often wanting; a pair of similar spines on the distal border of the gymnocyst, sometimes only one median spine, occasionally 4 or 6, curving forward over the opesia.

Avicularia buguloid, moveable on a short peduncle, characteristically paired and well separated one on either side of the midline, only one may be present, either lateral or median, or occasionally both wanting; length 0.18 to 0.26 mm; rostrum decurved at the tip, the mandible evenly arcuate, with a small curved tip.

Ovicell hyperstomial, evenly rounded, attached to the distal end of its zooecium by a rather broad base; the surface faintly and radiately striate; width 0.22 mm, length 0.20 mm.

The frontal membrane is delicate and there is no evidence of a chitinized operculum. There are multiporous septulae in the lateral walls and a row of uniporous septulae in the distal wall. Radicles wanting.

Type, AHF no. 41.

Type locality, Hancock Station 557-36, off White Rock, Isla Partida, Gulf of California, 28°55′30″N, 113°05′35″W, 45 fms, four colonies; also at 468-35, Port Parker, Costa Rica, 5 fms, one colony; 147-34 and 155-34, Tagus Cove, Albemarle Island, Galapagos, 30 to 60 fms.

Genus **DENDROBEANIA** Levinsen, 1909

Genotype, *Flustra murrayana* Johnston, 1847.

This genus was separated from the old genus *Bugula* by Levinsen because of the presence of a distinct operculum and the nature of the distal wall which consists of a more horizontal part with a large multiporous rosette plate. In addition are the following characters: the proximal end of the zooecium is tubular and nearly transverse (i. e. the proximal end of the zooecium as seen on the dorsal side is not prolonged on either side to form a two-pronged fork, as it does in *Bugula*); there is a more heavily calcified area on the dorsal and lateral walls distally, and in this area are the large single terminal and one or two lateral multiporous rosette plates.

The species of *Dendrobeania* are usually multiserial and frond-like, erect or more or less recumbent, but occasionally may be biserial. Usually there are two sizes of the stalked avicularia, those on the outer zooecia being much the larger; occasionally, however, avicularia may be lacking.

KEY TO SPECIES OF *Dendrobeania*

1. Avicularia present. 2
 Avicularia absent. 4
2. Spines well developed, the distal pair erect, lateral ones curving over the opesia. *murrayana*
 Spines weak, lateral spines often wanting. 3
3. Occasional small lateral spines; avicularium, especially the beak, elongated. *curvirostrata*
 Only weak spines at distal corners; avicularia stout and bulbous; zoarial fronds very broad. *multiseriata*
4. A pair of very heavy spines at the distal corners pointing forward and outward, behind these 4 to 6 strong lateral spines on each side bending across the opesia. *longispinosa*
 Spines fewer, shorter and weaker. 5
5. Zooecia loosely connected, sometimes with small fenestrae between them; zoarium semi-erect or recumbent, with irregular branches of greatly varying width. *laxa*
 Zooecia closely connected; spines sometimes vestigial; zoarium recumbent with broad rounded lobes. *lichenoides*

Dendrobeania murrayana (Johnston), 1847

Plate 25, fig. 1

Bugula murrayana, Hincks, 1884:6.

Bugula murrayana, Robertson, 1900:320; 1905:266.

Bugula murrayana, O'Donoghue, 1923:20; 1925:99; 1926:44.

The zooecia are elongate, the opesia occupying most of the frontal area; an erect spine at the distal outer angle and a varying number of smaller ones on the inner and outer margins curving more or less over

the opesia. Pedunculate avicularia situated near the base, those on the outer margins considerably larger than those on the inner zooecia of a frond.

The ooecia are large, subglobose and marked by radiating lines.

This is a widely distributed species in northern seas. It shows much variation in the manner of growth, the typical form having erect or somewhat recumbent broad frond-like branches; the variety *fruticosa* (Packard) with narrower strap-like branches, and the variety *quadridentata* (Loven) uniserial to quadriserial, with all possible intermediate variations linking these different growth forms together.

Hincks, Robertson and the O'Donoghues have recorded the species at numerous localities from the Bering Sea to Puget Sound.

The species was not taken in the dredgings of the Allan Hancock Pacific Expeditions, but there is a specimen in the collections from Pavlov Bay, Alaska. Also in the material from the U. S. Alaska Crab Investigation, the varieties *fruticosa* and *quadridentata* occurred together at stations 60-40, Leonard Harbor, Alaska, 20 to 25 fms, and 139-40, off Hallo Bay, Alaska, 28 to 40 fms. It is an abundant species at Point Barrow, Alaska, G. E. MacGinitie, Arctic Research Laboratory.

Dendrobeania curvirostrata (Robertson), 1905

Plate 25, figs. 7 and 8

Bugula curvirostrata Robertson, 1905:272.
Bugula curvirostrata, O'Donoghue, 1923:21; 1925:99; 1926:45.

The growth habit is much like that of *D. murrayana* var. *fruticosa* (Packard), with strap-like branches consisting of about 4 to 8 series of zooecia. The spines are much weaker than in *murrayana,* often reduced to merely the projecting distal angles. Lateral spines are often wanting, but a short nearly erect weak spine may be present on one or both sides opposite the operculum. The most important differential character appears to be the form of the avicularium, which is much longer than that of *murrayana,* especially the beak. Both the beak and the mandible are so much curved that they meet only at their tips. This applies to both the large border avicularia and the smaller ones on the inner zooecia.

Robertson did not obtain it north of Monterey Bay, California, but O'Donoghue lists it for a number of localities in Puget Sound and British Columbia, at 6 to 20 fms.

Hancock Stations: 997-39, White Cove, Santa Catalina Island, 36 to 41 fms; 1150-40, Avalon Bay, Santa Catalina Island, 93 to 110 fms; 1187-40, off Bird Rock, Santa Catalina Island, 31 to 40 fms; 875-38, northwest of Anacapa Island, 50 fms; 990-39, San Miguel Passage, 37

to 39 fms; 1385-41, off East Point, Santa Rosa Island, 75 to 76 fms, southern California. Since the bathymetric range increases southward, it seems probable that this is a species of moderately northern distribution and that southern California may be about the southern limit.

Dendrobeania laxa (Robertson), 1905

Plate 25, figs. 2 and 3

Bugula laxa Robertson, 1905:275.
Bugula laxa, O'Donoghue, 1923:21; 1925:99; 1926:45.

This is a spreading, recumbent species, loosely attached by numerous radicles. The fronds vary greatly in width from 2 or 3 zooecia to many, and the intermediate variations appear to render the variety *attenuata* O'Donoghue (1923:21) merely a nominal one. All of the species of *Dendrobeania* that have come under our observation have this variability in width.

The zooecia are large, like those of the other species of the region, about 0.75 to 0.90 mm in length, and are more loosely connected with each other than in the other species. The absence of avicularia and the nature of the unusually heavy spines are the best diagnostic characters. The ooecia are large and prominent, length 0.24 mm, width 0.30 mm.

Robertson recorded the species from Puget Sound, Washington, to Monterey Bay, California, and O'Donoghue found it at several localities in British Columbia, shore to 20 fms.

Hancock Stations: 1232-41, 5 miles from San Pedro Breakwater, 17 to 19 fms; 1190-40, Anacapa Passage, 15 to 50 fms; 1271-41, Anacapa Island, 23 to 25 fms, southern California, and 1490-42, Cape Arago lighthouse, reef and bight, Coos Co., Oregon, intertidal.

Dendrobeania lichenoides (Robertson), 1900

Plate 25, fig. 6

Flustra lichenoides Robertson, 1900:322; 1905:291.
Flustra lichenoides, O'Donoghue, 1923:23; 1925:100; 1926:48.

This species is a typical *Dendrobeania* in the manner of budding, the large terminal and lateral rosette plates, the calcification of the lateral and basal terminal walls, and the nature of the ovicells.

The zoarium consists of very wide, lichen-like fronds which are recumbent and loosely attached by radicles. The zooecia appear to be thinner-walled and less heavily chitinized than is usual in the genus. The zooecia are large, 0.75 to 0.90 mm, occasionally more than 1.00 mm in length, considerably narrower on the proximal half and rather suddenly widened, the distal end rather evenly rounded. A minute spine, often

absent, is present on the outer angle and 2 or 3 small, weak spines on each side toward the distal end. As O'Donoghue indicates (1923:23) under his variety *spinosa,* there may be "a large number of more developed spines," but apparently this condition is not limited to "a much more slender and delicate habit of growth." Occasionally the spines may be entirely wanting.

The ovicell is characteristic of the genus, large, rounded and prominent with surface striations, and there are no avicularia.

Robertson indicated the range from Alaska to San Francisco, California, and O'Donoghue records it from numerous localities in British Columbia and Puget Sound.

Hancock Station 1490-42, Cape Arago lighthouse, reef and bight, Coos Co., Oregon, intertidal. Common at Dillon Beach, California, Menzies, collector, shallow water.

Dendrobeania longispinosa (Robertson), 1905

Plate 25, figs. 4 and 5

Beania longispinosa Robertson, 1905:277.

In spite of the occasional small irregular fenestrae and the general looseness of connection of the zooecia, this species belongs in the genus *Dendrobeania* for the following reasons: the distal ends of the lateral and basal walls are thickened and calcified and contain the large single distal and two disto-lateral rosette plates, as in *Dendrobeania,* and the ovicell is exactly like that of other species in this genus. Robertson indicates that the ovicell is small, but it is only small in comparison with the size of the zooecia, it measures 0.30 mm in width by about 0.24 mm in length, and it is striated in the pattern characteristic of the genus. The long and heavy distal spines are situated rather close together and point distally. The lateral spines, usually about 7 on each side, are strong, curved over the opesia and so long that they may reach beyond the opposite side of the zooecium. The zoarium is irregular, recumbent, the branches consisting of from one to six series of zooecia. There is no evidence of tubular connections, such as occur in the species of *Beania.*

Robertson had the species only from La Jolla, California, "in several fathoms of water."

Hancock Stations: 2158, north end of Ranger Bank off Cedros Island, Lower California, 81 fms; 1187-40, off Bird Rock, Santa Catalina Island, 31 to 40 fms; 1190-40, Anacapa Passage, 15 to 20 fms; 1271-41, three-fourths of a mile southeast of Cat Rock, Anacapa Island, southern California, 23 to 25 fms; 1896-49, Tanner Bank, 22 fms.

Dendrobeania multiseriata (O'Donoghue), 1925

Bugula multiseriata O'Donoghue, 1925:18.

This species evidently belongs in *Dendrobeania,* as O'Donoghue states that one zooecia arises from the other on the dorsal side by a quite straight transverse joint. Also the ovicell, in form, mode of attachment and surface decoration is typically that of a *Dendrobeania.* The very broad fronds and the presence of smaller avicularia on the inner zooecia suggest a close relationship to *B. murrayana* (Johnston). The absence of spines, except a very small one at each distal corner, and the form of the avicularia appear to distinguish it specifically, but it may prove to be only another variety of *B. murrayana.* Described from "St. Paul Island, Alaska."

Dendrobeania simplex (O'Donoghue), 1923

Flustra simplex O'Donoghue, 1923:24; 1926:48.

Zoarium erect, dichotomous, the branches consisting of 8 to 10 series of zooecia at their widest part; attached by radicles which arise from near the middle of the dorsal part of the zooecia.

Zooecia alternate, elongate, rounded distally and truncate at the base; aperture occupying the major part of the front. Spines absent or limited to small points at the distal corners. No avicularia.

Ooecia prominent, subglobose, with a slightly upturned lip, the surface with radiating striae (condensed from O'Donoghue's two accounts).

The ovicells in this species are very definitely hyperstomial, while those of the genus *Flustra* are endozooecial. The form, mode of budding (transversely across and closely attached to the distal end of the zooecium), and the nature of the decoration are all similar to the same characters in species of *Dendrobeania.* It is probably merely a variety of *D. lichenoides* (Robertson) in which the spines are often much reduced or wanting over much of the colony.

It was described from north of Gabriola Island and later listed from off Cape Lazo and Bull Passage, British Columbia. It did not appear in the Hancock dredgings.

Genus BEANIA Johnston, 1840

Genotype, *Beania mirabilis* Johnston, 1840.

In this genus the zooecia are more or less separated and connected by tubular extensions. In some species the connecting tubes are so short that at first view they may appear to be wanting; in other species the tubular portion may be as long or longer than the body of the zooecium. The

proximal end of the zooecium is always narrow and tubular where it takes its origin from dorsal side of the preceding zooecium. The distal end of the zooecium is raised, extended forward above, and not resting on the succeeding zooecium. Stalked, moveable avicularia are usually present, but occasionally absent. Ovicells are usually wanting or vestigial, but may be well developed. The species are recumbent, spreading over various types of substrata and attached by radicles which have their origin on the dorsal side.

KEY TO SPECIES OF *Beania*

1. Zooecia in a single series. 2
 Zooecia forming a network. 3
2. Basal tubule about as long as zooecial body, terminal spines short and weak. *mirabilis*
 Basal tubule only about one-third as long as body, terminal spines long and strong. *alaskensis*
3. Avicularia present, spines vestigial. *magellanica*
 Spines long and very numerous. 4
4. Connecting tubules nearly as long as the zooecia, 3 dorsal spines. *columbiana*
 Connecting tubules only one-fourth as long as the zooecia, 5 dorsal spines *hirtissima*

Beania mirabilis Johnston, 1840

Plate 26, fig. 8

Beania mirabilis, Robertson, 1905:276.

Beania mirabilis, O'Donoghue, 1926:45.

Beania mirabilis, Hastings, 1930:705.

The zoarium is uniserial, irregularly branched, spreading over algae, hydroids and other bryozoa, and attached by radicles which have their origin on the dorsal side near the proximal end of the zooecial body. The zooecia are tubular proximally for about one-half of their total length and expand rather suddenly to form the zooecial body which averages about 0.60 to 0.65 mm in length. The total length including the tube is usually well over 1.00 mm. The origin of the zooecial tube is on the dorsal side of the preceding zooecium at about the middle of its length. There are two pairs of short oral spines and 4 to 6 longer spines on each side which bend over the opesial area. Avicularia and ooecia not known.

This species is distributed around the world in temperate and tropical seas. On the west coast of the Americas it has been recorded previously from British Columbia to Colombia as follows: O'Donoghue, Gabriola Pass, British Columbia, 6 to 8 fms; Robertson, Dead Mans and Santa Catalina Islands, southern California, and Hastings, Gorgona, Colombia, 15 fms.

Hancock Stations: 147-34, Tagus Cove, Albemarle Island, Galapagos, 30 fms; 133-34, Braithwaite Bay, Socorro Island, west of Mexico, 20 fms; 1238-41, off Wilson Cove, San Clemente Island, southern California, 14 to 16 fms. The writer has also collected it on the piles of wharves in Newport Harbor, southern California. Also Gulf of Panama, Galtsoff collection, on pearl oysters.

Beania alaskensis new species

Plate 26, figs. 6 and 7

This species resembles *B. mirabilis* in form and mode of growth, but is much larger, the tubular proximal end much shorter and thicker, the distal spines are very elongate (nearly half as long as the zooecial body), and the lateral spines bifurcate at the base with the outer branch directed outward and the inner one curved over the opesia.

The total zooecial length is about the same as that of *B. mirabilis,* 1.00 to 1.10 mm, but the proportions of stalk and body are quite different as the tubular stalk is only one-third as long as the body, and the stalk is comparatively thick, 0.10 mm in diameter (0.05 mm in *mirabilis*). The very elongate terminal spines and the double lateral ones are also striking differential characters.

Type, AHF no. 42.

Type locality, Shuyak Strait, Afognak, Alaska, "U. S. National Museum 85/652."

Beania magellanica (Busk), 1852

Plate 25, fig. 9

Diachoris magellanica Busk, 1852:54; 1884:59.
Beania magellanica, Harmer, 1926:412.

The zoarium forms a network, or reticulum, the zooecia being separated from each other by fenestrae about one-third as large as the zooecia. The lateral connecting tubes vary somewhat, but average about 0.15 mm in length. Each zooecium begins in a narrow tube arising from the dorsal side of the preceding one and suddenly expanding into the "boat-shaped" zooecium. The zooecium (body) is moderately large, 0.65 mm long by 0.30 to 0.40 mm wide, slightly narrowed at the distal end where it projects above the succeeding one, and the opesia occupies the whole of the frontal surface. Vestigial spines are present, two at the distal end and one (occasionally two) on either side of the operculum. The avicularia are large and somewhat elongated (about 0.35 mm in length), with a

short stalk and sharply decurved beak, attached one on either side just proximal to the operculum. Harmer (1926:412) described extremely vestigial ovicells for this species, but these were not noted in our material.

This species is distributed around the world in the southern hemisphere and as far north as the Mediterranean Sea and Japan. In American waters it has hitherto been noted only at the Straits of Magellan (Busk), and Terra del Fuego and the Falkland Islands (Calvet).

Hancock Stations: 394-34, 843-38, and 844-38, Lobos de Afuera Islands, Peru, shore to 25 fms.

Beania hirtissima (Heller), 1867

Plate 26, figs. 4 and 5

Diachoris hirtissima Heller, 1867:94.
Beania hirtissima, Marcus, 1937:62.
Beania hirtissima, Osburn, 1940:397.

The zoarium usually forms a loosely attached spreading spinous mat, sometimes rising free and unilaminar, occasionally tubular in form, bristling like a porcupine. The zooecia are of moderate size, about 0.60 mm long from septum to septum, of which the proximal tubular portion is about one-fourth; widely separated by fenestrae which are about one-half as large as the zooecia, and connected by tubular lateral processes of the same length as the basal tubular portion but narrower. The astonishing array of spines shows three types: (1) distal straight spines projecting forward, laterally and more or less erect, 8 or 10 in number; (2) lateral spines 8 to 12 on each side, which curve over the opesia with their points often interlacing; and (3) dorsal spines, 5 in number, with the following arrangement,—one on each side between the distal and disto-lateral tubes, another between the disto- and proximo-lateral tubes, and one in the midline about the middle of the zooecium. Occasionally there is another single median spine near the proximal end of the zooecium, and this one frequently develops a branching hold-fast at its tip.

Avicularia and ovicells are wanting.

The species has a wide distribution in warmer waters, occurs on the Atlantic coast from Bermuda to Brazil, but has not been recorded previously from the Pacific coast of the Americas.

Hancock Stations: 303, Port Culebra, Costa Rica, 17 fms, 2 small colonies on a coralline nodule, and Station 313, Secas Islands, Panama, 25 fms.

Beania columbiana O'Donoghue, 1923

Beania columbiana O'Donoghue, 1923:22; 1926:46

This species has much resemblance to the widely distributed *B. hirtissima* (Heller), but O'Donoghue (1926:46) points out the differences as follows: much longer connecting tubules, the number and distribution of the marginal spines, and in the limitation of the dorsal spines to three.

The zoarium is a network loosely attached, the zooecia being connected by six tubules, each nearly as long as the zooecium, to the neighboring zooecia. The membranous frontal area is surrounded on the sides and distally by long chitinous spines, 21 to 30 in number, many of which are bifurcate; on the dorsal side are three bifurcate spines regularly located between the distal and lateral connecting tubules. Banks Island, Cape Ebenshaw and China Hat, British Columbia (O'Donoghue). Not in the Hancock collections.

Division VI **CRIBRIMORPHA** Harmer, 1926

This Division was established by Harmer to include all of the genera in which the frontal shield, or pericyst, is formed by the union of hollow spines or costae, more or less fused, with pores (lacunae) between the costae, the "cribrimorphs" of Lang. Opinions vary as to where in the evolutionary series this group should be placed. Marcus (1922:47) included it in the Ascophora, but has since returned it to the Anasca. Canu and Bassler (1929:27-30) divided the group between the Anasca and Ascophora, and Bassler (1935:29) includes all of the cribrimorphs in his Division I of the Ascophora.

In separating this Division, Harmer discussed the possible evolution of the compensation sac of the Ascophora through conditions which are found in the reduction of the costal area of *Figularia,* which almost bridge the gap between the Anasca and Ascophora. He considers that "the Cribrilinidae are a transitional group, and it is thus a matter of legitimate doubt whether they should be placed in the lower or the higher of the two groups which they connect." Silen (1942:41-52) discussed the formation of the ascus (compensation sac) and the calcified frontal and concluded that the ascus has been evolved from the space between the membraniporidan frontal membrane, which forms the floor of the sac, and the inner layer of the calcified frontal wall, which forms its roof.

Since practically all of the Cribrilinidae, the recent cribrimorphs, have a broad membraniporidan frontal membrane below the pericyst (some of the genus *Figularia* seem to be exceptions), it appears more logical to retain this group in the Anasca, even though they suggest the evolution of

the Ascophora. Certainly such typical cribrimorphs as *Cribrilina, Lyrula* and *Reginella* with a large costal area above a broad frontal membrane cannot properly be included in the Ascophora.

The family Cribrilinidae includes practically all of the recent genera.

Family **Cribrilinidae** Hincks, 1880

Key to the Genera of Cribrilinidae

1. No ooecia, no dietellae, avicularium large, vicarious, spatulate. *Lyrula*
 Ooecia present, hyperstomial; avicularia not spatulate. 2
2. Avicularia present. 3
 Avicularia wanting (in the species here considered). 4
3. Avicularia vicarious or pedunculate at side of aperture . *Colletosia*
 Avicularia minute, mandible setose. *Puellina*
4. Costules separated for most of their length. . . *Membraniporella*
 Costules more or less fused for their entire length. 5
5. Costate area reduced, costae closely united, no dietellae, gymnocyst well developed. *Figularia*
 Costate area covering nearly the whole front. 6
6. Ooecia large, prominent, no dietellae. *Reginella*
 Ooecia small, not prominent, dietellae present. . . . *Cribrilina*

Genus **MEMBRANIPORELLA** Smitt, 1873

The frontal membrane is overarched by a series of costules which are free from each other for much of their length, but more or less fused at their tips; the distal pair forming the proximal lip of the aperture. Paired avicularia may occur at the sides of the aperture, but are not found in our species. The ovicell is hyperstomial. Dietellae present or wanting. Genotype, *Lepralia nitida* Johnston, 1847:319.

Membraniporella aragoi var. **pacifica** new variety

Plate 27, figs. 3 and 4

Encrusting, especially on shells. It has all the appearance of a membranipore with an arched lattice-work above the frontal membrane. The zooecia are moderate in size, but show much variation, 0.40 to 0.65 mm long by 0.30 to 0.40 mm wide. The frontal shield or pericyst is formed by the fusion of the branched tips of large, flattened, hollow spines which arise on the mural rim, curve over the frontal membrane and interlock, leaving usually 6 or 8 more or less ellipsoid lacunae in the central area. The usual complement of the spines or costulae is 4 on each side, but there may be as few as 3 or as many as 6 in the same zoarium; frequently there is a single median costa proximally; the costae are separated at

their bases and for half or more of their length by long slits. There is a short, flattened spine at each side of the aperture, with 2 or 3 very short points; in the ovicelled zooecia these spines are more or less fused with the sides of the ooecia. In the absence of ooecia there is a small median spine on the distal border. There are no avicularia.

The ooecia are hemispherical, prominent and wide open; the ectooecium does not form a complete cover but leaves a somewhat v-shaped frontal area which, in complete calcification, terminates in a pointed umbo at the top. The ooecium is about 0.20 to 0.25 mm broad by 0.13 mm long.

The general appearance is that of Savigny's figure of *Flustra aragoi* Audouin, with the exception that the ovicell is somewhat longer and the lateral oral spines are short and end in 2 or 3 tubercles, instead of being branched in alcicorn fashion and extended backward on the sides of the aperture. There appears to be a tendency toward a greater number of costae, but Savigny's figure 1, shows 5 costae on a side. Marcus, 1938:30, has recorded *aragoi* from Santos Bay, Brazil, with two pairs of costae and 3 to 4-branched lateral oral spines. Harmer, 1926:473, described *aragoi* from the East Indies with 3 to 5 pairs of costae and short-bifurcate oral spines. Also Canu and Bassler (1928-35) have described, from north of Cuba, *M. petasus,* in which the costae are usually 4 to 6, the lateral oral spines short-bifid (occasionally trifid in the writer's specimens from the Caribbean Sea), but the central area of the front is usually more closed and a lacunae smaller. I am inclined to the view that all of those are to be considered varieties of *aragoi,* especially as I have a colony from the Caribbean which is almost the exact counterpart of Savigny's figure with the 4-pronged lateral spine which extends backward on the side of the aperture, sometimes even fusing with the proximal branch of the first costa; but in the same colony there are occasional shorter trifid spines.

Type, AHF no. 43.

Type locality, Hancock Station 924-39, Socorro Island, 18°41′52″N, 110°55′20″W, 17 to 46 fms. Also at Stations 129-34, Socorro Island, and 135-34 and 219, Clarion Island, west of Mexico; 143-34, Wenman Island and 224, Albemarle Island, Galapagos; 270, Angel de la Guardia Island, Gulf of California; and 224, San Benito Island, Lower California. Bathymetric range, 2 to 100 fms.

Membraniporella pulchra new species

Plate 27, figs. 5 and 6

The zoaria are small, encrusting, on the dorsal side of *Cupuladria canariensis* (Busk). The zooecia are moderately small, averaging 0.40 mm in length (range 0.35 to 0.44); well separated, with narrow interopesial areas; costa very regular, 6 to 8 pairs, situated close together, sometimes almost closing the lateral lacunae; central area comparatively large and regular in form, with 10 or 12 or even a larger number of small lacunae. The lateral oral spines are flattened at the base but usually end in a single point, occasionally short-bifid; a small median terminal tubercle in the absence of the ooecium. The distal pair of costae form the proximal border of the aperture, which is slightly arcuate and without an umbonate process. A slight median keel is occasionally present.

The ooecium is hemispherical, 0.18 to 0.20 mm wide by 0.15 mm long, with the usual v-shaped area on the front.

The species is evidently related to *M. aragoi,* but the much smaller size, the larger number of costae, the much narrower lateral lacunae, the larger and more regular central area and the simplicity of the lateral oral spines seem sufficient to require specific standing. Whether the peculiar habitat on the dorsal side of *Cupuladria* has any meaning is a question.

Type, AHF no. 44.

Type locality, Hancock Station 135-34, Sulphur Bay, Clarion Island, west of Mexico, 18°20′20″N, 114°44′25″W, 25 fms. Also at Sta. 921-39, north of Clarion Island, 30 to 33 fms.

Membraniporella crassicosta Hincks, 1888

Plate 27, figs. 1 and 2

Membraniporella crassicosta Hincks, 1888:216.
Membraniporella crassicosta, Osburn, 1912:279.

Zoarium a coarse reddish brown incrustation which may rise in bilaminate frill-like folds to the height of an inch. The zooecia are large, 0.60 to 0.90 mm long by 0.45 to 0.55 mm wide, and coarse. The aperture is large, 0.25 mm long by 0.30 mm wide, rounded distally with the proximal border somewhat straighter. The spines forming the pericyst are unusually broad and heavy, ordinarily fused only at the tips, the first pair forming the border of the aperture. In young colonies there are usually three pairs of spines (occasionally an extra 1 or 2) and there is some resemblance to *M. aragoi* (Audouin), as Hincks points out, though the zooecia are much larger. Away from the center of the colony only the two distal pairs are fully developed, the others represented by

mere stubs or absent. There is a peculiarity in the distal pair of spines, the bases of which are continued forward to form the lateral borders of the aperture; these are fairly regular but other spines vary widely in form, size and amount of fusion.

No ovicells have been observed. No oral spines, no avicularia, no dietellae.

Described from the Gulf of St. Lawrence (Hincks), and reported from Shoal Tickle, Labrador (Osburn). The occurrence of this species from northwestern Alaska indicates that it is probably circumpolar in distribution.

Point Barrow, Alaska, 20 fms, G. E. MacGinitie, Arctic Reasearch Laboratory, common and forming large colonies.

Genus **CRIBRILINA** Gray, 1846

Costules generally closely attached throughout their length, leaving lacunae of various sizes (more or less irregularly spaced in the type). Ovicell hyperstomial and closed by the operculum. The proximal rim of the orifice often with a mucro. Avicularia, when present, at either side of the orifice. Dietellae present. Genotype, *Lepralia punctata* Hassall, 1841:368.

Cribrilina annulata (Fabricius), 1780

Plate 28, fig. 7

Cellepora annulata Fabricius, 1780:436.
Cribrilina annulata, Osburn, 1933:32.
Not *C. annulata,* Robertson, 1900:280 (see *Lyrula hippocrepis*).
Cribrilina annulata, O'Donoghue, 1923:30; 1926:50.

The zoaria encrust shells and stones, forming small rounded colonies of a reddish or brownish color, *"pulcherrima et perfectissima haec omnium visarum"* (Fabricius, *Cellepora annulata,* 1780:436).

The zooecia vary greatly in size, 0.45 to 0.65 mm long by 0.30 to 0.40 mm wide, and in addition the ovicelled zooecia are often much reduced. The pericyst is formed by about 8 pairs of costae which are transverse distally but radiate at the proximal end; the costae are separated by rather deep grooves which extend across the whole of the front, except when interrupted at the median line by a low carina. In the grooves on each side there are about 4 (3 to 6) small rounded lacunae. The distal pair of costae form the proximal border of the aperture which usually bears an umbonate process more or less developed. The aperture is transverse (about 0.18 mm wide), somewhat semicircular, and on each side is a short strong spine; a pair of similar but somewhat smaller spines at the distal corners. There are no avicularia.

The ooecium is small and low and the distal spines are usually fused with it on the sides.

It is a common species on both sides of the North Atlantic, down to Cape Cod, Massachusetts, in the high Arctic it extends from the Kara Sea to the American Arctic, and has been recorded by O'Donoghue at several localities in British Columbia.

Collected by the "Albatross" at Cordova, Alaska, June 28, 1914, specimens in the National Museum and the Hancock collections. Also common at Point Barrow, Alaska, G. E. MacGinitie, collector, Arctic Research Laboratory.

Cribrilina corbicula (O'Donoghue), 1923

Membraniporella corbicula O'Donoghue, 1923:30.
Cribrilina corbicula, O'Donoghue, 1926:51.

Zoarium forming rough light brown patches on the leaves of *Zostera.* Zooecia of moderate size, oval and closely packed. Pericyst formed by 6 or 7 pairs of spines, uniting in the midline and at several points on each side, leaving 3 or 4 lacunar pores in each groove, presenting the appearance of basket-work. The aperture is semicircular, the apertural bar forming a sort of lip. Oral spines 3 or 4. Ovicell small, hemispherical, with 2 minute frontal pores; another pair of broad ribs grows across it and almost hides the ovicell. (Condensed from O'Donoghue's two accounts.)

This may be a different species, as O'Donoghue states that it is "a much larger form than *C. annulata.*" However, the nature of the small ovicell and the apertural bar and frontal rib of the ovicell in the form of raised lips suggest a close relationship to that species. Recorded from Nanaimo, Victoria and Nanoose Bay, British Columbia, by O'Donoghue. Not in the Hancock collections.

Genus **REGINELLA** Jullien, 1886

Zooecia with the frontal formed by voluminous ribs much in relief on the exterior surface, with the pores diminishing in size from the talon of the rib to its extremity; between each pair of ribs transversely is found a furrow often as broad as the rib, at the bottom of which each pore occupies the middle of a calcareous polygonal cell. These intercostal furrows traverse entirely the zooecium and separate completely each pair of transverse ribs. Orifice arched in front with the inferior lip mucronated, marginal spines. Avicularia unknown (Transl. Canu and Bassler). Genotype, *Cribrilina furcata* Hincks.

Jullien apparently drew his generic description entirely from Hincks' brief description and figure of *C. furcata* and the species and genus do not seem to have been given any later study. It may be added that the fertile zooecia have a wider aperture than the infertile ones (see Hincks' illustration, 1882, pl. 20, fig. 5); the lateral oral spines are not always bifurcate and are often wanting, and that communication is by multiporous septiulae.

There is a question as to whether *Metracolposa* Canu and Bassler (1917:34) is congeneric with *Reginella*. The Eocene, Middle Jacksonian, genotype, *M. robusta* Canu and Bassler, 1917:33, and some other Eocene species have vicarious avicularia. Otherwise they appear to be similar to *Reginella*.

Key to Species of *Reginella*

1. Short, strong, flattened spinous processes on either side of the aperture. 2
 Spinous processes wanting. 3
2. A single spine, usually bifurcate, on each side; ooecium with numerous pores, its width 0.30 mm. *furcata*
 Two spines on each side, not or only slightly furcate; ooecium with few pores, its width 0.40 mm. *spitsbergensis*
3. Apertural bar (proximal border) heavy, broad and mucronate. *mucronata*
 Apertural bar not unusually heavy, not mucronate. 4
4. Zooecia large (0.60 to 0.80 mm long), lacunar pores rounded, large. *nitida*
 Zooecia smaller (0.40 to 0.55 mm long), lacunar pores narrow and slit-like. *mattoidea*

Reginella furcata (Hincks), 1884

Plate 28, fig. 3

Cribrilina furcata Hincks, 1884:12.
Cribrilina furcata, O'Donoghue, 1923:30.
Reginella furcata, O'Donoghue, 1926:52.

Zoarium encrusting. Zooecia moderate in size, 0.50 to 0.65 mm long by 0.35 to 0.45 mm wide, distinct with deep grooves, regularly arranged in quincunx. The pericyst is considerably inflated, formed by the fusion of 6 to 8 pairs of costae, with or without a median keel. Each costa bears 2 to 4 oval lumen pores and between the costae there are 5 to 6 rounded lacunar pores. The pair of costae which form the proximal border of the aperture are not enlarged nor umbonate, but at most are slightly bowed forward. The aperture is transverse, about 0.18 mm wide by 0.12 mm long, rounded distally and transverse or a little incurved on the proximal

border. On either side of the aperture is a short, broad spine which is sometimes bifurcate, often merely pointed and frequently wanting. There are no avicularia.

The ovicell is prominent, 0.25 to 0.30 mm broad, sometimes longer than broad and a little pointed at its distal extremity, with a low broad keel and with larger pores around the border and smaller ones on the top.

Described by Hincks from Cumshewa and Houston-Stewart Channel, and listed by O'Donoghue from numerous other localities in British Columbia.

Hancock Stations: 1119-40, off San Benito Islands, west coast of Lower California, and 1303-41, Santa Cruz Island, off southern California. Also at Middle Bank, Puget Sound, Dr. J. L. Mohr, collector. Shallow water to 87 fms.

Reginella mucronata (Canu and Bassler), 1923

Plates 28, fig. 4 and 29, fig. 3

Metracolposa mucronata Canu and Bassler, 1923-926.

Zoarium encrusting, usually on stones and shells. The zooecia are ventricose and prominent, sharply set off from each other by deep grooves. The frontal shield or pericyst is formed by the fusion of 5 or 6 pairs of rather regularly arranged costae which meet at the midline either smoothly or with a low median keel. Each costa bears two small rounded lumen pores and between the costae there are 5 or 6 rounded or somewhat slit-like pores (lacunae). The pair of costae which form the proximal border of the aperture are elevated into a bimucronate lip. There are no spines, no avicularia and no dietellae. Zooecial length, average, 0.50, width 0.35 mm.

The ooecium is large and conspicuous, 0.26 to 0.30 mm wide, rather deeply embedded and bears a variable number of pores, irregularly distributed, the marginal ones being somewhat larger. Often a carina is present and the area just distal to the aperture may be flattened on each side and irregularly striated longitudinally. The ooecium is usually noticeably longer than broad, but in crowded areas the reverse may be true.

Canu and Bassler described *M. mucronata* from "Pleistocene: Santa Barbara, California, (rare)." I have not been able to find any constant difference between recent and fossil material. The original description does not mention the pores of the ovicell, but fossil specimens sent me by Dr. Bassler show the character of the pores, usually occluded by fossilization. The variations in measurement transcend in both directions those of Canu and Bassler.

This species is here placed in the genus *Reginella* since it resembles *R. furcata* (Hincks) in all fundamental characters, except in the absence of the lateral oral spines, which are also often wanting in *furcata*. It is more heavily calcified and the proximal lip of the aperture is stronger and more or less bimucronate. In the very young zooecia it is difficult to distinguish the two species and I can find no differences in the ancestrulae.

It is a common species, occurring at 29 of the Hancock dredging stations and also along shore, from the northern Channel Islands off southern Calfornia southward to Cedros Island, Lower California, and also at San Esteban Island in the Gulf of California. It is present in the Pleistocene from Santa Barbara to Newport Harbor, southern California. The known distribution is from about 35 N Lat. to 28 S Lat. and from shallow water to 121 fms.

Reginella nitida new species

Plate 28, fig. 1

Zoarium encrusting. Zooecia moderately large (0.60 to 0.80 mm long by 0.40 to 0.55 mm wide), distinct and regularly disposed. The pericyst is lower, less arched, than in *mucronata* and is smooth and shining even in older stages; occasional traces of a carina. There are 6 to 8 pairs of costae, with often a median one at the proximal end, each with 3 small lumen pores which are often obscured. The intercostal grooves are broad and extend across the front in full width; lacunae 6 (5 to 7), not much reduced toward the midline, round or elliptical in form. The proximal border of the aperture is thin in younger zooecia, but becomes heavier with age and forms a vertical rim which often terminates in a low median umbonate process; it does not extend forward toward the aperture but projects directly upward. The aperture of the infertile zooecia measures 0.18 to 0.20 mm in width, while that of the fertile ooecia is about 0.24 mm. The ovicell appears to be exactly like that of *mucronata* but larger, 0.30 to 0.35 mm wide. There are no spines, no avicularia, and no dietellae.

In general appearance it is like *R. mucronata,* but it is much larger, less ventricose and is smooth and shining at all stages; there are one or two more pairs of costae and usually two more lacunae in each row. The appearance is neater than in *mucronata* which is much rougher and more irregular even when growing on a smooth surface.

Type, AHF no. 45.

Type locality, Hancock Station 1181-40, off Howlands Landing, Santa Catalina Island, southern California, 33°28′15″N, 118°26′48″W, 49 fms. Also at Stations 1251-41, five and a half miles south of San Benito

Islands, Lower California, 28°12′35″N, 115°34′35″W, 69 fms, and Raza Island, 28°48′00″N, 113°00′00″W, Gulf of California, 40 fms. Also at Middle and Hein Banks, Puget Sound, Washington, Dr. J. L. Mohr, collector.

Reginella mattoidea new species

Plate 28, fig. 2

Zoarium encrusting on shells, worm tubes and nullipores, dull white (mattoid) like a delicate patina, even the youngest zooecia very little shining. Zooecia of moderate size, 0.40 to 0.55 mm long by 0.35 to 0.40 mm wide, the smallest of our species. The pericyst is ventricose but less so than in *mucronata;* costules usually 6 pairs (5 to 7), broad at the base and narrowing nearly to a point at the center of the front, the lumen pores small, 1 to 3 in number, often only the outer one present; grooves broad and extending in full width across the front, the lacunae 7 to 10 on each side, narrow and slit-like; rarely there is a trace of a carina. The costae forming the proximal border of the aperture are broad, with a strong vertical raised rib across its upper surface and extending slightly around the angles of the aperture. The aperture is comparitively small (0.12 mm long by 0.14 mm wide in the infertile zooecia, and 0.16 mm wide in the fertile zooecia).

The ovicell is round, moderately large (0.26 mm in either dimension) with numerous pores, roughened and with the same texture as the pericyst.

It is more delicate and neater in appearance than the other species of the genus; the narrower aperture, the finer character of the pericyst with a larger number of lacunae, are evident. No spines, no avicularia and no dietellae.

Type, AHF no. 46.

Type locality, Hancock Station 1064, off Santa Barbara Island, California, 33°39′01″N, 119°02′20″W, 27 fms, 7 colonies. Also at Stations 137-34, Clarion Island, west of Mexico, 57 fms, and 275, Raza Island, Gulf of California, 28°48′00″N, 113°00′00″W, 40 fms. Albatross Station 2994, Revillagigedo Islands, west of Mexico.

Reginella spitsbergensis (Norman), 1903

Plate 28, figs. 5 and 6

Cribrilina annulata var. *spitsbergensis* Norman, 1903:103.
Cribrilina annulata, Waters, 1900:64.
Cribrilina annulata var. *spitsbergensis,* Nordgaard, 1918:50.

Zoarium encrusting on shells, one colony covers an area 20 by 25 mm, light reddish brown in color. The zooecia are large, averaging 0.78 mm long by 0.47 mm wide, very regular in arrangement. The pericyst is thick, formed of about 7 pairs of costae, the proximal ones radiate and the distal ones transverse; the distal pair of costae unite to form the proximal border of the aperture which is a little elevated and sometimes forms a low mucro. The aperture measures about 0.25 mm in width by 0.17 mm long, roughly semicircular, straighter on the proximal border. The peristome is low, with four short, strong, flattened spinous processes which bend slightly over the aperture; the proximal pair, usually smaller, are opposite the proximal border of the aperture, the distal pair opposite the distal end of the aperture. The costae are strong with three to five irregularly rounded lacunar pores between; the lumen pores usually two.

The ooecium is large (0.40 mm wide), the front usually a little flattened with a narrow keel and a few pores, partially embedded in the base of the distal zooecium. The distal pair of spinous processes unite more or less with the front of the ovicell, but do not enter into its formation; instead they "form two outspread wings overhanging the oral opening." (Norman, p. 104). The fertile zooecia are not reduced in size (as in *C. annulata*) but are similar in all respects to the others, except for the slightly wider aperture.

In raising this form to specific rank the following characters are of importance: the large size of the zooecia (noted by Waters and Norman), the replacement of spines of *annulata* by broad processes with the proximal pair in a different position, and the nature of the ovicell which is very much larger, of different form and not surrounded by a small kenozooecium. For these reasons also, as well as the agreement with *Reginella furcata,* the species is transferred from *Cribrilina* to *Reginella.* Waters, under *Cribrilina annulata,* noted the presence of the lateral oral processes. These structures are homologous to the costae and in series with them but are short and nearly erect. Norman considered it a variety of *annulata* but questioned whether it should not be "regarded as a species." It has been recorded from Franz-Josef Land, Spitzbergen, Greenland and the White Sea. No doubt it is circumpolar in distribution, and it has not been observed out of the high Arctic region.

Collected by Prof. G. E. MacGinitie at Point Barrow, Alaska, several colonies on shells, at 22 fms, Arctic Research Laboratory.

Genus LYRULA Jullien, 1886

Costules large, separated by broad furrows which extend across the front; orifice shaped like an inverted lyre. Avicularia interzooecial, large and spatulate, often wanting. No ooecia. Dietellae wanting, but multiporous septules are present in both distal and lateral walls. Genotype, *Cribrilina hippocrepis* Hincks.

Lyrula hippocrepis (Hincks), 1882

Plate 27, figs. 7 and 8

Cribrilina hippocrepis Hincks, 1882:470.
Cribrilina annulata, Robertson, 1900:326.
Cribrilina hippocrepis, Robertson, 1908:280.
Cribrilina hippocrepis, O'Donoghue, 1923:30.
Lepralia regularis, O'Donoghue, 1923:40.
Lyrula hippocrepis, O'Donoghue, 1926:52.

The species has been well described by Hincks and by Robertson, but without calling attention to the variability, which is very marked. In older stages the calcification is exaggerated and takes various forms, one of which led O'Donoghue to describe it as a new species, which he corrected later (1926:52).

Zoarium encrusting, or rarely erect and bilaminate. The zooecia are regularly disposed in alternating series when not crowded; distinct, but the separating grooves may become filled in old specimens; moderately large, 0.50 to 0.75 mm long by about 0.40 mm wide; ventricose when young but becoming nearly flat with age. The pericyst is formed by 5 (4 to 6) pairs of broad costae, each with a large pore (pelma) at its base; the separating grooves are broad and each bears 5 or 6 small slit-like longitudinal lacunae. The distal costae, which form the aperture bar, are unusually broad; there is no median umbo, but in older zooecia there is often a lateral umbonate protuberance which develops in connection with the lateral costal pore. In older stages all of the lateral costal pores may be surrounded by short, stout, erect collars. The aperture, about 0.20 to 0.20 mm is widest and straight on its proximal border, narrowed to form lateral indentations, then evenly rounded to conform with the border of the operculum; the latter is well chitinized, with a strong bordering sclerite, but incomplete proximally.

Large vicarious avicularia, often wanting even in whole colonies, occupy a position in the zooecial series; the mandible long and subspatulate, with a long-triangular basal sclerite and attached without pivot or cardelles.

Robertson described the ovicell as "globose, or medium wide, punctured with a few large pores," but Hincks failed to find them, O'Donoghue did not mention them, and in the numerous specimens at my disposal there are none. Frankly, I do not know how to interpret Dr. Robertson's illustration (pl. 15, fig. 31); it shows a narrow costal border to the aperture and omits the large basal pores (pelmata) of the costae, and shows ovicells similar to those of *Reginella,* but also shows the larger avicularium. As Miss Robertson did not mention the very common *Reginella mucronata* (Canu and Bassler), it is possible that she confused it with *Lyrula hippocrepis* and combined them in her illustration.

Various British Columbia localities, Hincks and O'Donoghue; Yakutat, Alaska, and San Pedro and Coronados Islands, southern California, Robertson.

In the Hancock expeditions this species was recovered at 38 different stations ranging from the coast of Oregon to the Gulf of California. It is very abundant about the Channel Island region off southern California. The known range is from Yakutat, southern Alaska (Robertson), to about the 26th N parallel of latitude; the bathymetric range is from shallow water to 79 fms.

Genus **PUELLINA** Jullien, 1886

Jullien erected this genus to include *Cribrilina gattyae* Busk, the only species known to him, which therefore becomes the genotype. Later other species were added by various authors. Most of these, however, appear to fall more properly in the genus *Colletosia* Jullien, 1886, which had been neglected until resurrected by Harmer (1926:474). *Colletosia,* of which *Lepralia endlicheri* Reuss is the genotype, has quite a different frontal shield.

In *Puellina* the costal area does not occupy all of the frontal, but has a comparatively broad gymnocyst border, especially at the proximal end; there is a small setose avicularium ("vibracellaire," Jullien) at each side of the aperture, and no interzooecial avicularia. The frontal usually bears a distinct rounded umbo near the center of the pericystal area, and oral spines are present.

Puellina setosa (Waters), 1899

Plate 29, fig. 4

Cribrilina setosa Waters, 1899:8.
Cribrilina radiata var. *a* Hincks, 1880:186.
Cribrilina radiata, form *innominata,* form with *vibraculoid setae,* Hincks, 1884:14.

Zoarium encrusting in a thin white layer on shells and stones. The zooecia are small, averaging about 0.40 mm long by 0.30 mm in width though there is much variation and shorter zooecia may be as broad as long, and their inflated costate areas cause them to appear very distinct. A smooth border, often quite conspicuous at the proximal end, surrounds the area which often is almost round. The pericyst is formed by 6 to 8 spines on each side, the distal pair uniting to form the proximal border of the aperture, while the others unite at the center of the front where they usually produce a small round low umbo at some distance back of the oral border. The lacunae are rounded, 2 to 4, except on the apertural bar where there is usually only one in the middle (occasionally 2 or 3). The aperture is small, semicircular, 0.08 mm wide by 0.05 mm long; the operculum thin with a slightly thickened border which is continuous except on the proximal margin; the peristome low, with 3 to 5 small slender spines. A minute setose avicularium is situated on either side of the aperture about opposite the proximal border; the chamber is minute and, though muscles are present, I have been unable to determine their mode of operation.

The ovicell is hyperstomial, hemispherical, prominent, about 0.18 mm wide and long, with a low longitudinal keel from which delicate striae radiate.

The species has much resemblance to *P. gattyae* (Busk) from the coasts of Europe, but comparison with Mediterranean specimens of that species shows the costal area of *setosa* to be larger, the spines smaller, and the zooecia somewhat larger.

Recorded by Waters from Madeira and Naples, and by Hincks from the British Islands and British Columbia.

Hancock Stations: 431-35, off Octavia Rocks, Colombia; 155-34, Albemarle Island, Galapagos; 873-38 and 1269-41, Anacapa Island, and 1050, San Miguel Island, southern California; and Albatross Sta. 2886, off the coast of Oregon, 20 to 60 fms. Also several colonies collected by Dr. John L. Mohr at Friday Harbor, San Juan Island, Puget Sound, Washington.

Genus COLLETOSIA Jullien, 1886

Costae separated by a row of small lacunae. Orifice semicircular with oral spines. Avicularia vicarious or absent. The ovicell is hyperstomial. Dietellae present. (After Harmer, 1926:474). Genotype, *Lepralia endlicheri* Reuss, 1874.

Jullien's genus *Colletosia* was submerged for many years under *Puellina* Jullien, 1886, but Harmer (1926:474) resurrected it. After studying the genotype of *Puellina,* (*Lepralia gattyae* Busk), I fully agree with Harmer that "this species does not seem to be congeneric with *C. radiata.*"

Jullien's original description of the genus does not conform in all respects to that of Harmer, given above, as he states that the furrows, or intercostal grooves, are entirely without pores and that there are no oral spines. These are characters that are readily obscured in fossilization, however, and as Harmer has made a careful study of the case the genus *Colletosia* may be considered acceptable for *radiata.*

Colletosia radiata (Moll), 1803

Plate 29, figs. 2 and 2a

Cribrilina radiata, Hincks, 1884:14.
Cribrilina radiata, O'Donoghue, 1923:30.
Puellina radiata, O'Donoghue, 1926:51.
Colletosia radiata, Harmer, 1926:475.
Colletosia radiata, Osburn, 1947:26.

Zoarium encrusting, small white colonies on shells, worm tubes, pebbles, etc. The zooecia are distinct, separated by deep grooves; costate area convex and covering nearly all of the frontal; costae usually 7 or 8 pairs and between them radiating rows of small lacunae which are often somewhat slit-like; one or more small lacunae in a median position near the aperture; an umbonate process sometimes present. Aperture semicircular, straight on the proximal border, with about 5 oral spines. Vicarious avicularia, with an elongate mandible, irregularly distributed and often wanting even on whole colonies.

Ovicell rounded, smooth or radiately roughened, usually with a small carina or umbo.

There is a great deal of variation in most of the characters; size, number of costae, amount of calcification, number and form of the preapertural pores, the size and form of the avicularium, the size and distribution of the setae, etc. and a number of nominal varieties have been described. The best known of these is the *Lepralia innominata* Couch, 1844, which has been accepted as a distinct species by most authors, on

the basis of a single lunate suboral pore. However, there is too much variation in the number, size and form of these pores to be of specific value; often there is a single larger pore, which may be lunate in form (*innominata*), but which is more often round and varies greatly in size; again instead of a single pore there may be 2 to 4 smaller ones, and the two near the middle may be partially united to form a dumb-bell shaped central pore.

The vicarious avicularia are variable in size and number, the mandible usually long triangular, but may be hastate in form (var. *flabellifera* Kirkpatrick). Several fossil varieties have also been given names, and Canu and Bassler (1923:98, 90) list var. *scripta* Reuss, and var. *rarecosta* Reuss from the Pleistocene of California.

It is a cosmopolitan species. Hincks and O'Donoghue listed it, in the typical form, from a number of British Columbia localities.

In the Hancock collections it appears abundantly, 59 stations, from the coast of Oregon south to the Galapagos Islands and the coast of Peru, shallow water down to 136 fms.

Colletosia bellula new species

Plate 29, fig. 1

Zoarium forming small white, glistening colonies on shells and pebbles. The largest colony observed was only two and one-half mm across and those less than two mm may be mature with ovicells.

Zooecia separated by broad, deep sulci; moderate in size, 0.35 to 0.50 mm long; the gymnocyst is scarcely visible, nearly the whole front being covered by the pericyst, which consists of 6 or 7 pairs of costulae which radiate toward the center. Between the costulae are rows of about 8 slit-like lacunae; the outer ends of the costules are only slightly elevated.

The aperture is decidedly lepralioid in form (0.12 mm long by 0.08 mm wide), rounded anteriorly, with a pair of large "cardelles," proximal to which is a broad transverse poster with a nearly straight border. The apertural bar is slightly raised to form a thin, smooth lip and distal to the cardelles a low thin peristome extends around the aperture; 2 to 4 small oral spines are present in young zooecia but these soon disappear.

Another striking character, in addition to the form of the aperture, is the pair of minute, pedunculate avicularia, one on either side opposite the distal end of the aperture; the mandible is triangular, pointing more or less inward and forward.

The primary ovicell is small (about 0.15 mm in either dimension), smooth, hemispherical and appears to be closed by the operculum; it soon

becomes covered by an ectooecium which is composed of 3 or 4 pairs of radiating costules similar to those of the front and with similar lacunae. The costules form strong buttresses around the outer border and meet at the top in a small umbonate process. The sides of the ectooecium extend backward to the avicularian processes.

The ancestrula is membraniporoid with 4 minute spines on either side; it measures 0.26 mm long by 0.18 mm wide.

In six colonies studied no vicarious avicularia were observed. The oral avicularia appear to arise from the zooecial border just outside of the peristome. Dietellae similar to those of *C. radiata* are present.

Notwithstanding the form of the aperture and the presence of frontal avicularia, this species appears to be congeneric with *C. radiata,* as the nature of the frontal, the dietellae and the closure of the ovicell are those of *Colletosia.*

Type, AHF no. 47.

Type locality, Hancock Station 270, east coast of Angel de la Guardia Island, Gulf of California, 29°29′00″N, 113°27′00″W, 14 fms, two colonies. Also at Station 155-34, off Tagus Cove, Albemarle Island, Galapagos Islands, 50 to 60 fms, 3 colonies; 275, Raza Island, Gulf of California, 40 fms, and off Magdalena Bay, Gulf of California, 18 fms. Also from the Pleistocene of Newport Harbor Mesa, southern California, 1 colony complete with ovicell, within the cup of *Discoporella umbellata,* G. P. Kanakoff, collector.

Genus **FIGULARIA** Jullien, 1886

Pericyst with well-defined costae, usually with numerous fusions giving rise to a row of lacunae, occasionally without lateral fusions, the costae then separated by undivided slits. Orifice closed by a completely chitinized operculum which articulates with lateral condyles. Oral spines usually wanting. Ovicells large, hyperstomial, the ectooecium generally with membranous fenestrae. Avicularia, when present vicarious. No dietellae. The gymnocyst usually covering a considerable portion of the frontal area. (After Levinsen, 1909). Genotype, *Lepralia figularis* Johnston, 1847:314.

Figularia hilli new species

Plate 28, fig. 8

Zoarium unilaminar, encrusting shells, pebbles and occasionally algae, yellowish in color. Zooecia moderately large and convex, separated by broad sulci. The gymnocyst is well developed, occasionally occupying half or even more of the frontal area, but usually not more than one-fourth, smooth and imperforate. The frontal shield is raised above the level of the gymnocyst and varies greatly in size, a character common to the species of this genus. At its fullest development it consists of 7 costulae (3 pairs and one median), but 5 or 6 is a common number and as few as 3 have been observed. The distal pair form the apertural bar, usually thicker than the others, but not elevated into a prominent lip. The remaining costules are usually completely fused for their entire length, but some small slit-like lacunae may be present and small pores occur at the center of the shield. The fused tips of the costules may be elevated into a low, irregular umbonate process at their point of fusion. Each costule bears a large membranous pelma (lumen pore), shaped like an elongated tear-drop, narrow and pointing toward the center, the ones on the apertural bar being similar in size and form. On the proximal, median costule the proximal border of the pelma is often elevated into a small umbonate process.

The aperture is nearly circular, slightly straighter on the proximal border, with distinct cardelles, distal to which there is a slightly raised, thin, smooth peristome. In the fertile zooecia the side walls of the aperture bear a pair of much abbreviated costules, each with a short, wide pelma. No spines nor avicularia have been observed.

The ovicell is only slightly elevated, transverse, very short, scarcely longer than the one pair of costules of which the ectooecium appears to consist. The characteristic "tear-drop" pelma of the costules form the fenestra on each side. The ovicells are so inconspicuous that they are most easily located by noting the larger aperture of the fertile zooecia.

Measurements. Zooecial length 0.65 (0.50 to 0.75) mm; width 0.40 (0.35 to 0.50) mm. Aperture length 0.15 to 0.18 mm; width 0.18 mm. Aperture of ovicelled zooecia, length 0.15 to 0.18 mm; width 0.20 to 0.22 mm. Ooecial length 0.10 to 0.15 mm; width 0.30 to 0.35 mm.

The species is dedicated to Dr. Howard R. Hill of the Los Angeles County Museum, who presented me with the first specimen, collected at Redondo Beach, southern California.

Type, AHF no. 48.

Type locality, Hancock Station 1130-40, off Laguna Beach, California, 33°32′40″N, 117°48′45″W, 29 fms. Other stations are 1139-40, off Redonda Beach, 20 fms; 1232-41, San Pedro Breakwater, 18 fms; 1271-41, Anacapa Island, 25 fms; 1295-41, Santa Cruz Island, 19 fms; 1303-41, Santa Cruz Island, 47 fms. Other records are: Monterey Bay, A. E. Blagg, collector, Newport Harbor, R. C. Osburn, collector, and Santa Catalina Island. All of the above localities are in California waters, and as far as our records go this species is limited to southern California shores and islands, from Monterey Bay to Santa Catalina Island, and from low tide to 47 fms.

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ILLUSTRATIONS

The figures have all been drawn, under the author's direction, by the following artists on the Hancock Foundation staff: Mr. Anker Peterson, Miss Mary Taylor, Mr. Mitchell Crawley and Mr. Russell D. Cangialosi. Their careful work is here recognized with sincere thanks.

In order to facilitate size comparison, all of the figures were outlined under the camera lucida at the same enlargement, with the exception of a few which are specially indicated in the descriptions of the plates. All of the figures are from Pacific coast specimens.

TYPES

Type specimens are all deposited in the Allan Hancock Foundation, unless otherwise indicated in the text.

PLATE 1

Fig. 1. *Aetea truncata* (Landsborough).

Fig. 2. *Aetea recta* Hincks.

Fig. 3. *Aetea anguina* (Linnaeus).

Fig. 4. *Aetea ligulata* Busk.

Fig. 5. *Scruparia ambigua* (d'Orbigny).

Fig. 6. *Eucratea loricata* (Linnaeus), frontal view and branching.

Fig. 7. The same, side view.

Fig. 8. *Membranipora mebranacea* (Linnaeus).

Fig. 9. The same, showing a "tower cell."

Fig. 10. *Membranipora villosa* (Hincks), normal zooecium above with chitinous frontal spinules, below the twinned ancestrula with bases of five buds.

Fig. 11. The same, showing chitinous corner spines and a larger one at the division of a series of zooecia.

Fig. 12. *Membranipora serrilamella,* new name, average development of the cryptocyst.

Fig. 13. The same, showing development of the tubercles by folding of the distal wall.

Fig. 14. *Membranipora fusca,* new species.

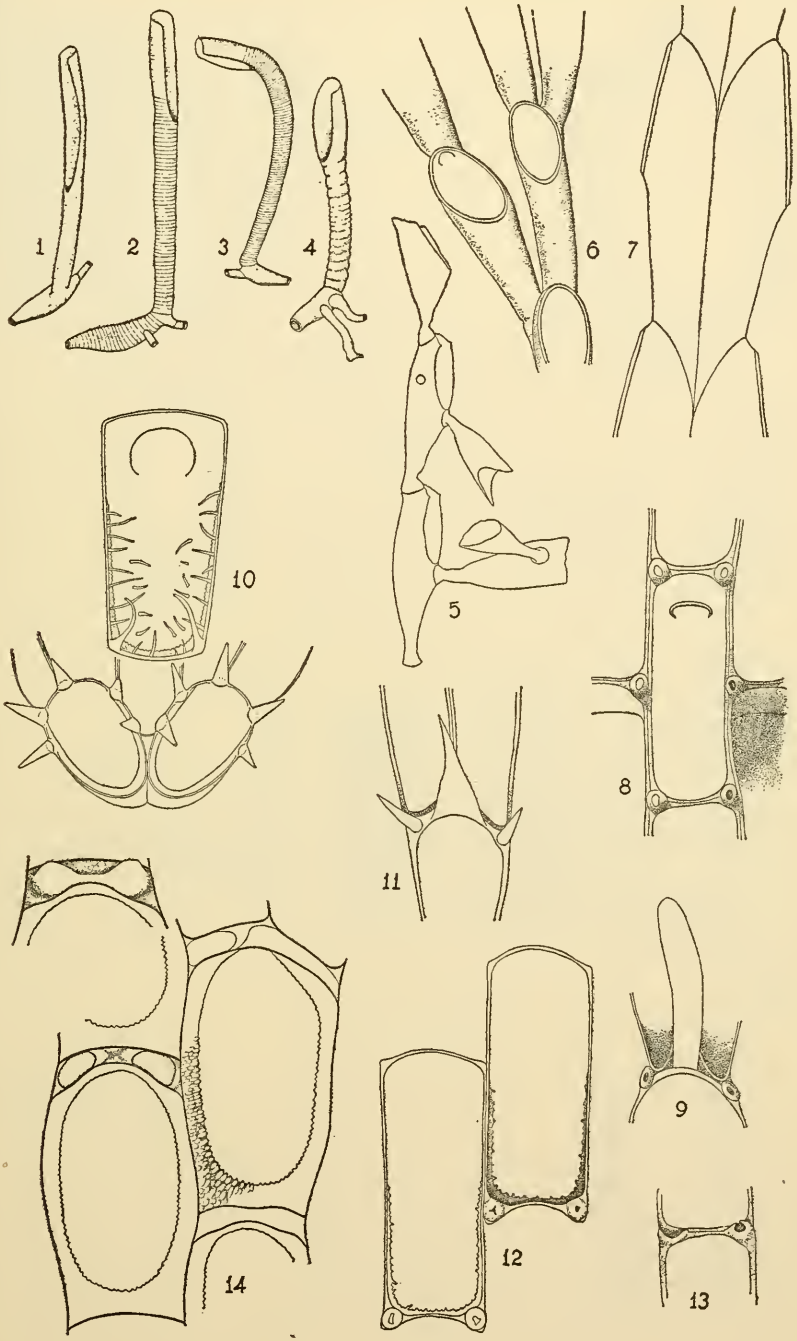

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PLATE 2

Fig. 1. *Membranipora hastingsae,* new species. = M. annae nom nov.

Fig. 2. *Membranipora pachytheca,* new species, with frontal ectocyst.

Fig. 3. The same, ectocyst removed.

Fig. 4. *Membranipora tuberculata* (Bosc), with tubercles, cryptocyst and internal spinules.

Fig. 5. The same, young with partially developed tubercles.

Fig. 6. The same, with three elongate tubercles.

Fig. 7. *Membranipora savarti* (Audouin).

Fig. 8. *Membranipora perfragilis* (MacGillivray).

Fig. 9. *Membranipora tenuis* Desor.

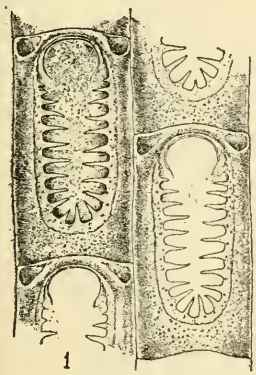
Fig. 10. The same, older stage of calcification.

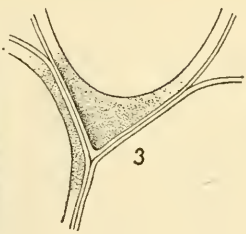
Fig. 11. *Conopeum reticulum* (Linnaeus), showing development of tubercles on the basal gymnocyst.

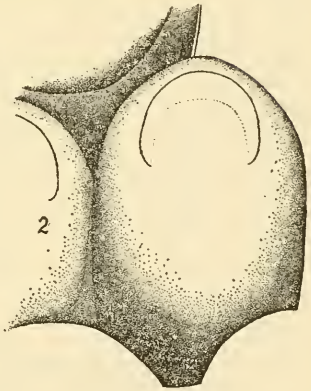
Fig. 12. *Conopeum commensale* Kirkpatrick and Metzelaar, with ectocyst decorated with chitinous spinules.

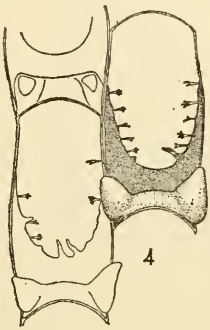
Fig. 13. The same, ectocyst removed.

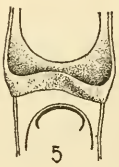
Figs. 14 and 15. The same, showing basal tubercles.

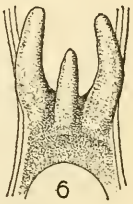

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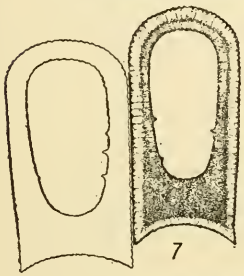

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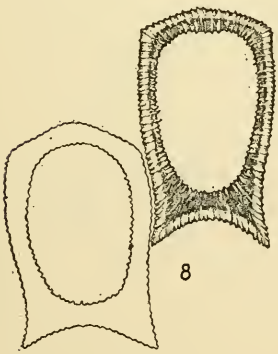

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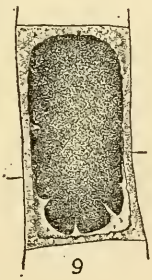

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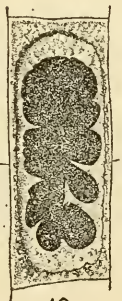

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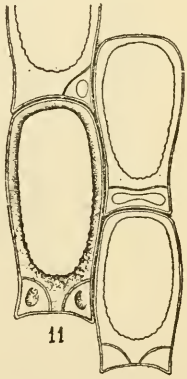

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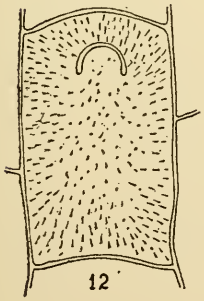

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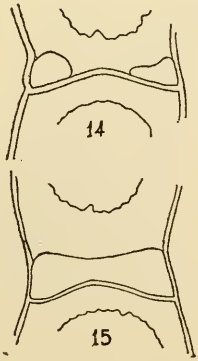

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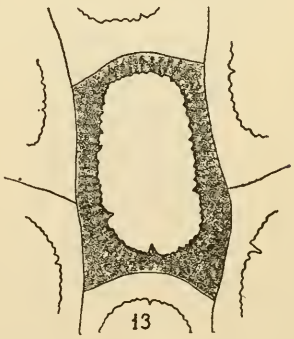

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PLATE 3

Fig. 1. *Desmacystis sandalia* (Robertson), with ribbed gymnocyst and median avicularian.

Fig. 2. *Cupuladria canariensis* (Busk), zooecia and distal vibracular chambers.

Fig. 3. The same, dorsal side showing pores.

Fig. 4. *Electra crustulenta* (Pallas), var. *arctica* Borg.

Fig. 5. The same, another variety.

Fig. 6. *Electra anomala* new species, with remarkable decoration of branched chitinous spines on the operculum.

Fig. 7. *Electra biscuta* new species, complete development with branched spines.

Fig. 8. The same, young stage.

Fig. 9. *Carbasea carbasea* (Solander).

Fig. 10. *Terminoflustra membranaceo-truncata* (Smitt), showing the vicarious avicularium.
(Figs. 9 and 10 reduced ½ in comparison with other figures.)


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PLATE 4

Fig. 1. *Aplousina filum* (Jullien) with minute endozooecial ovicell.

Fig. 2. *Alplousina major,* new species.

Fig. 3. *Cranosina colombiana,* new species, showing spines, dietellae and vicarious avicularia.

Fig. 4. *Ellisina levata* (Hincks), showing the vicarious avicularia,

Fig. 5. *Antropora granulifera* (Hincks). The avicularia appear to be frontal, but dissection shows them to be vicarious in origin.

Fig. 6. *Antropora claustracrassa* (Canu and Bassler). The interzooecial position of the avicularia is apparent.

Fig. 7. *Antropora tincta* (Hastings).

Fig. 8. *Mollia patellaria* (Moll), outer portion of zoarium without connecting tubules.

Fig. 9. The same, near center of zoarium, showing connecting tubules and dorsal attachment processes.

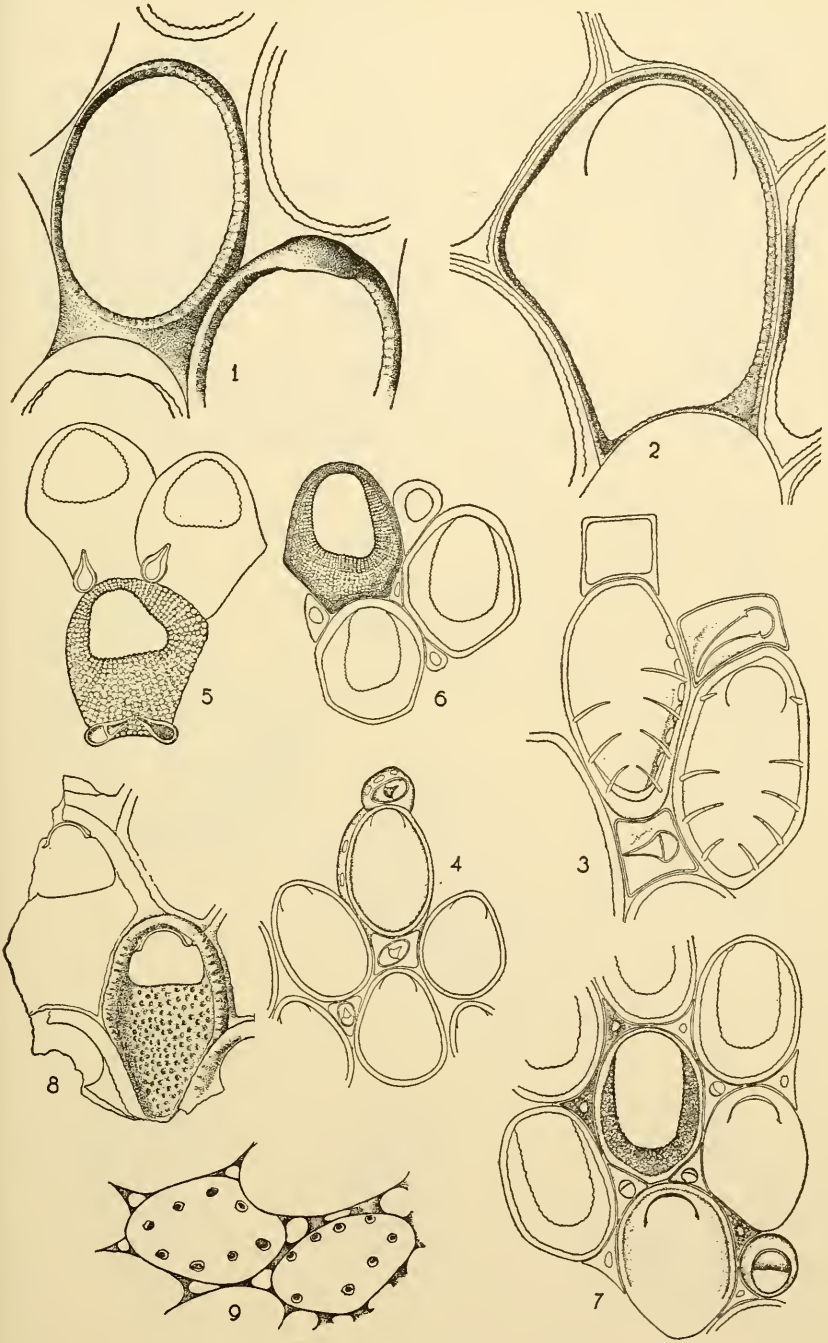

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PLATE 5

Fig. 1. *Hincksina pacifica* new species. Endozooecial ovicell.

Fig. 2. *Hincksina alba* (O'Donoghue). Endozooecial ovicell.

Fig. 3. *Hincksina velata* (Hincks), showing distorted mandible.

Fig. 4. The same, endozooecial ovicell.

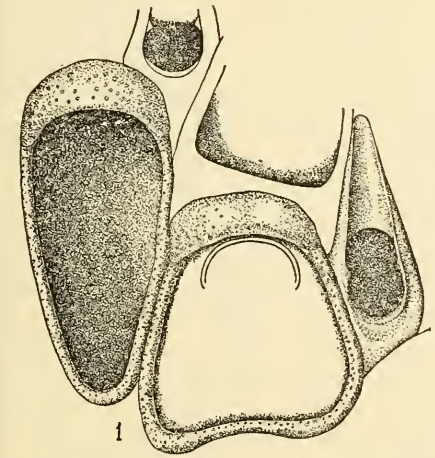
Fig. 5. *Hincksina nigrans* (Hincks), lateral avicularia and endozooecial ovicell.

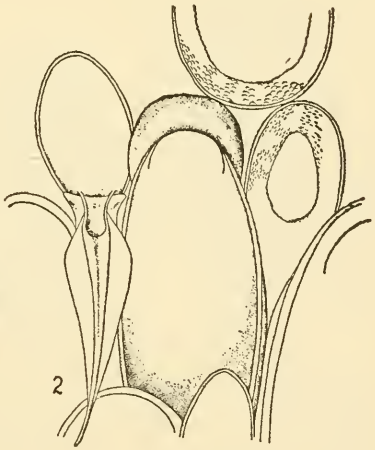
Fig. 6. *Cauloramphus brunea* Canu and Bassler.

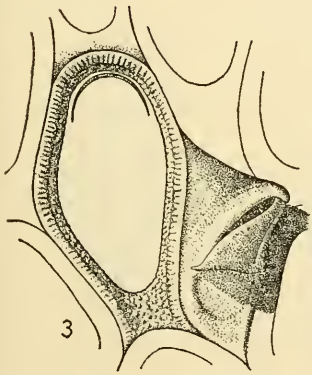
Fig. 7. *Cauloramphus cymbaeformis* (Hincks).

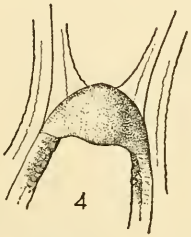
Fig. 8. *Cauloramphus echinus* (Hincks).

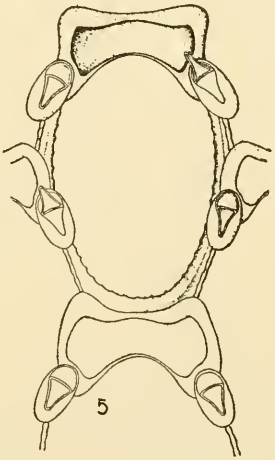
Fig. 9. *Cauloramphus spiniferum* (Johnston).

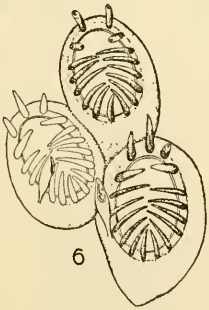

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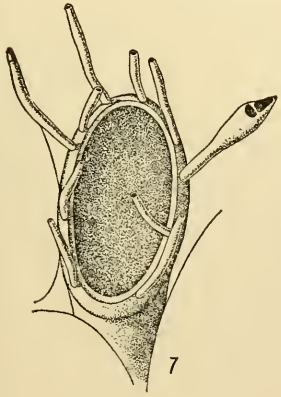

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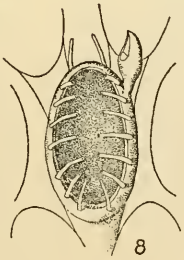

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PLATE 6

Fig. 1. *Membraniporidra porosa* new species.

Fig. 2. *Alderina smitti* new name.

Fig. 3. *Alderina brevispina* (O'Donoghue).

Fig. 4. *Callopora lineata* (Linnaeus).

Fig. 5. The same, showing ovicell and avicularium.

Fig. 6. *Callopora whiteavesi* Norman.

Fig. 7. *Callopora craticula* (Alder).

Fig. 8. *Callopora exilis* (Hincks).

Fig. 9. *Callopora horrida* (Hincks).

Fig. 10. *Callopora armata* O'Donoghue.

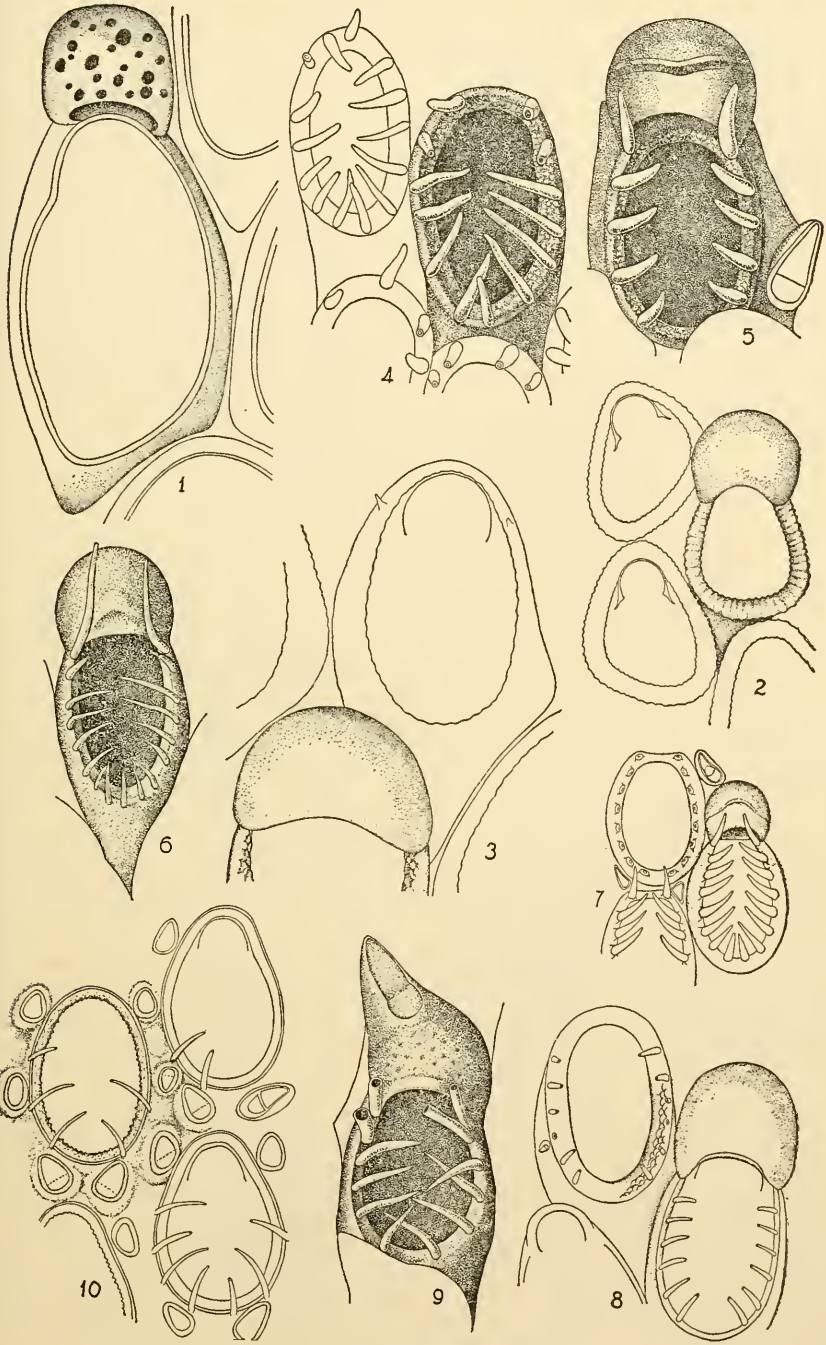

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PLATE 7

Fig. 1. *Callopora corniculifera* (Hincks), ovicell and two sizes of lateral avicularia.

Fig. 2. *Callopora aurita* (Hincks). Note difference in orientation of avicularia in presence or absence of ovicell.

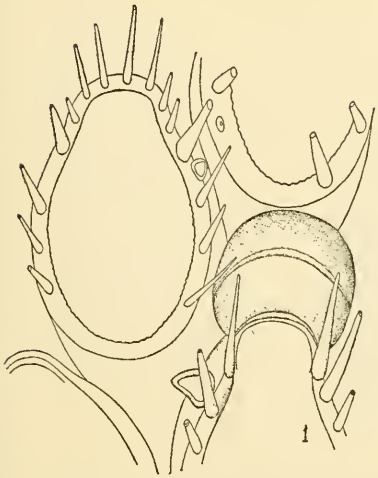
Fig. 3. *Copidozoum spinatum* new species. Note vicarious avicularium and array of spines.

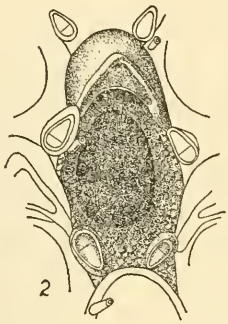
Fig. 4. *Copidozoum tenuirostre* (Hincks).

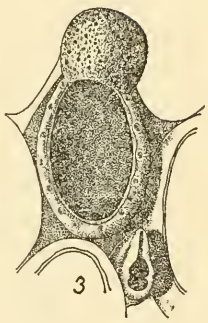
Fig. 5. *Copidozoum protectum* (Hincks).

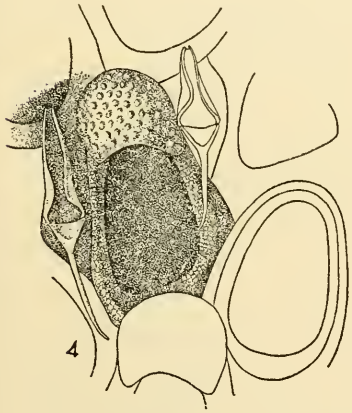
Fig. 6. *Retevirgula areolata* (Canu and Bassler), showing vicarious avicularia, connecting tubules and fenestrated ovicell.

Fig. 7. *Retevirgula lata* new species. Zooecium and ovicell and two kenozooecia, one with an avicularium.

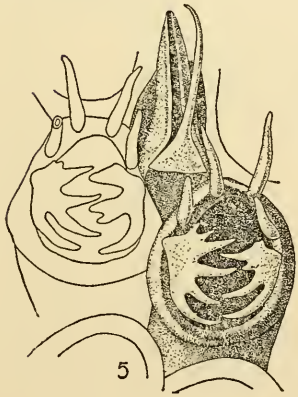

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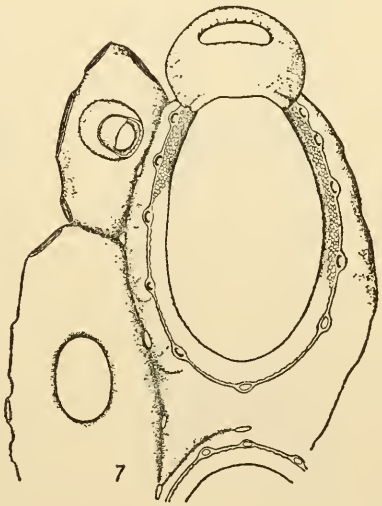

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PLATE 8

Fig. 1. *Retevirgula tubulata* (Hastings).

Fig. 2. *Callopora circumclathrata* (Hincks).

Fig. 3. *Doryporella alcicornis* (O'Donoghue), with branched spines and lateral avicularia.

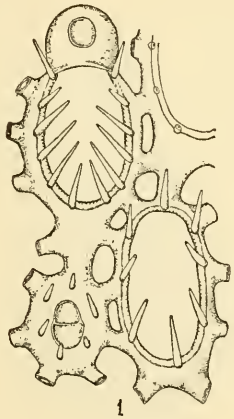
Fig. 4. *Doryporella spathulifera* (Smitt), with paired lateral avicularia and the bases of median avicularium and spine.

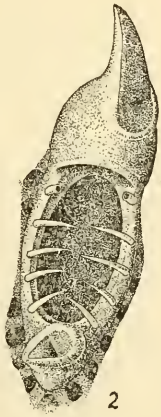
Fig. 5. The same, median avicularium and hastate spine, jointed at the base.

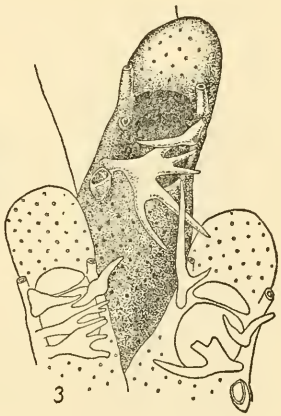
Fig. 6. *Bidenkapia spitsbergensis* (Bidenkap).

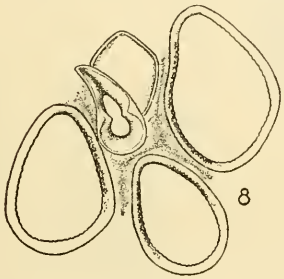
Fig. 7. *Bidenkapia spitsbergensis* var. *alaskensis* new var. Note small avicularia, even in the presence of an ovicell.

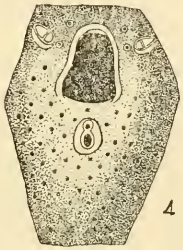
Fig. 8. *Parellisina curvirostris* (Hincks).


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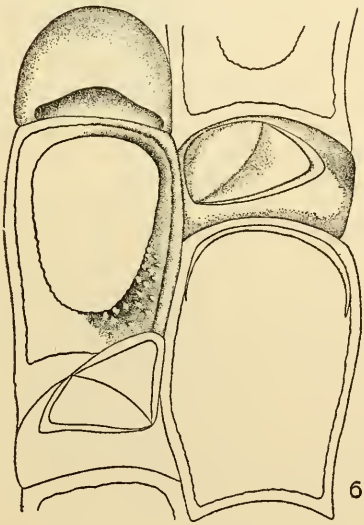

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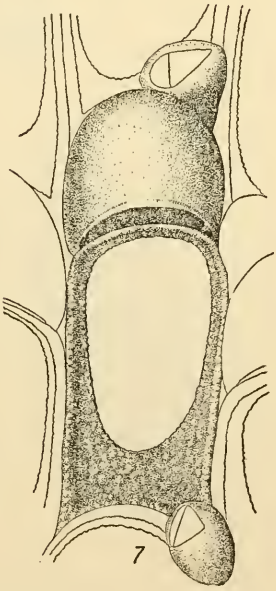

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PLATE 9

Fig. 1. *Tegella armifera* (Hincks), lateral avicularia directed backward.

Fig. 2. *Tegella unicornis* (Fleming).

Fig. 3. *Tegella magnipora* new species. Note absence of avicularia and the presence of a large fenestra or pore at distal end of ovicell.

Fig. 4. The same, showing secondary calcification of ovicell.

Fig. 5. *Tegella robertsonae* O'Donoghue.

Fig. 6. *Tegella arctica* (d'Orbigny), with lateral avicularia directed forward and smaller ovicell.

Fig. 7. *Tegella armifera* var. *cassidata* (O'Donoghue), with more elevated avicularia.

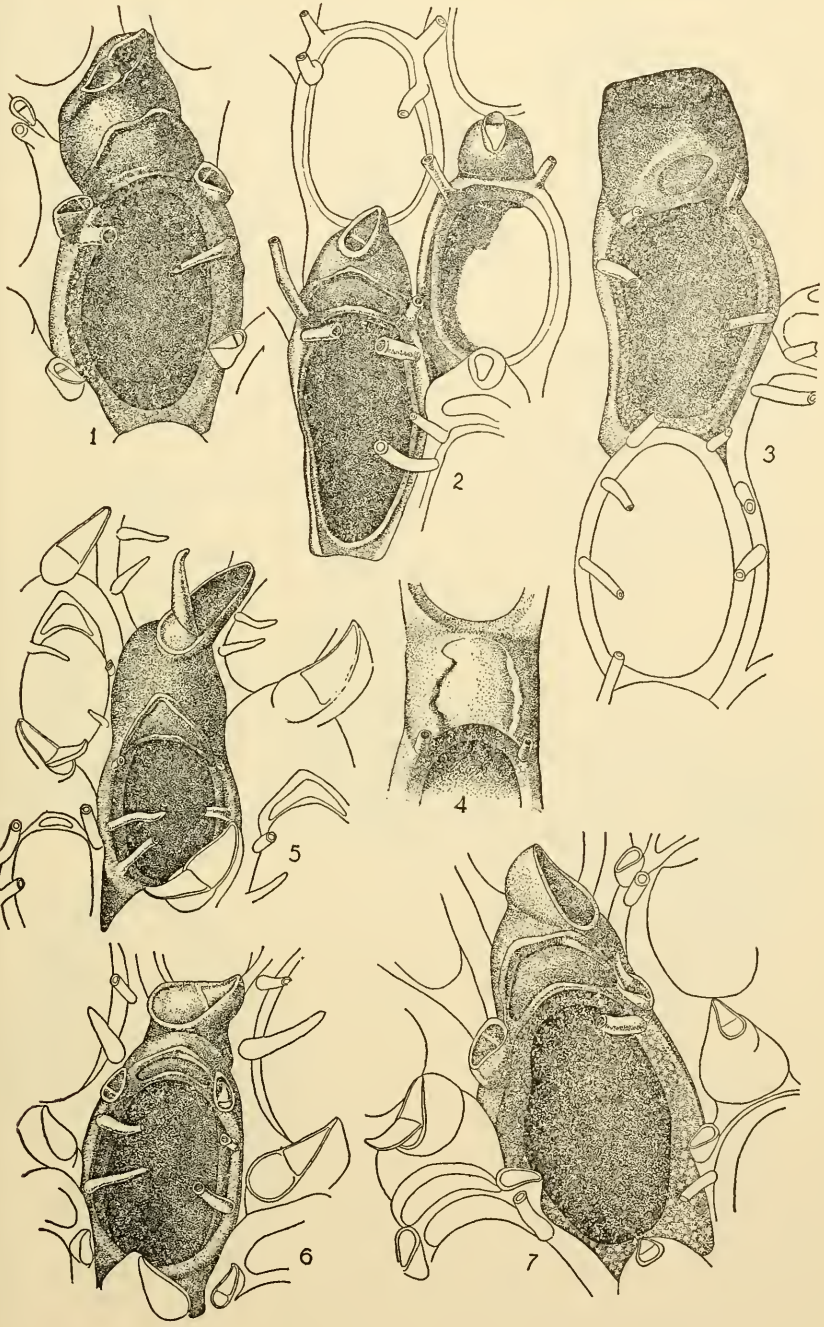

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PLATE 10

Fig. 1. *Chapperia patula* (Hincks).

Fig. 2. The same, showing details of the skeleton.

Fig. 3. *Chapperia condylata* Canu and Bassler, showing avicularia in the presence and absence of ovicell.

Fig. 4. *Chapperia frontalis* new species. Branching spines fuse to form a shield above the opesia.

Fig. 5. *Chapperia californica* new species. Note elongated opesia and form and decoration of ovicell.

Fig. 6. *Chapperia longispina* new species. Two forms of avicularia in presence or absence of ovicell.

Fig. 7. The same, showing the distal side of the ovicell with its peculiar avicularium.

Fig. 8. *Tremogasterina granulata* var. *subspatulata* new var.

Fig. 9. *Exechonella antillea* (Osburn).

Fig. 10. The same, dorsal side showing the attachment processes.

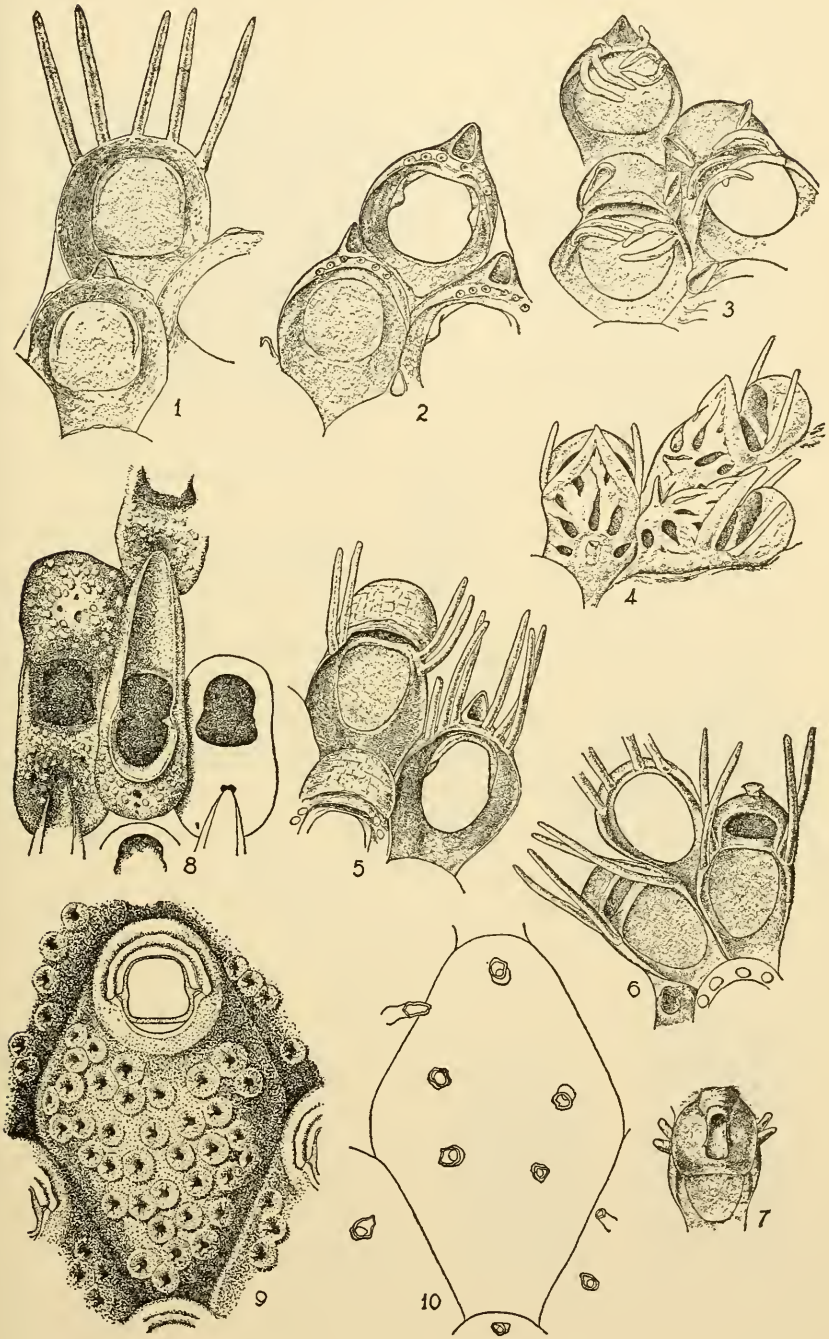

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PLATE 11

Fig. 1. *Anexechona ancorata* new species. Note especially the large vicarious avicularia with "grappling-hook" mandibles.

Fig. 2. *Microporina borealis* (Busk), zooecium and avicularium.

Fig. 3. *Micropora coriacea* (Esper), zooecium, avicularium and ovicell.

Fig. 4. *Floridina antiqua* (Smitt), zooecium and avicularium.

Fig. 5. *Onychocella alula* Hastings, zooecium and avicularium.

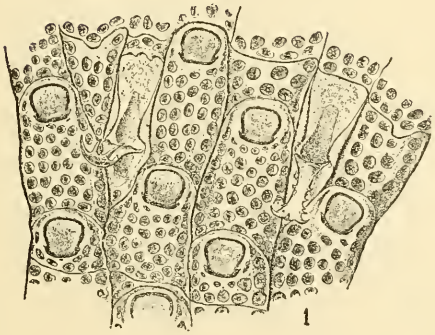
Fig. 6. The same, details of mandible.

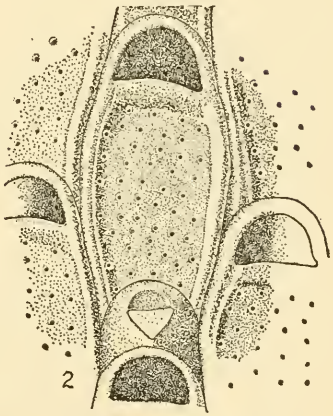
Fig. 7. *Discoporella umbellata* (Defrance), zooecium and vibracular chambers.

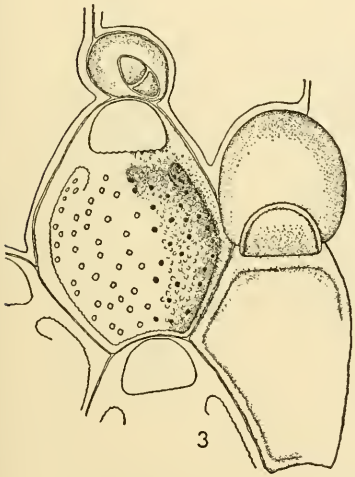
Figs. 8, 9, 10. The same, variations in zoarial form.

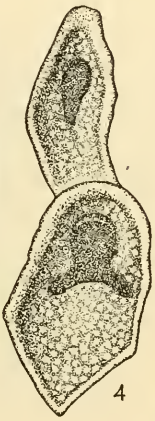
Fig. 11. *Caleschara mexicana* new species, details of zooecium.

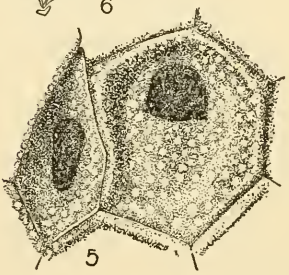
Fig. 12. *Labioporella sinuosa* Osburn.

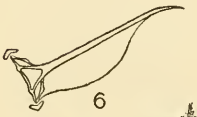

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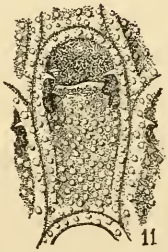

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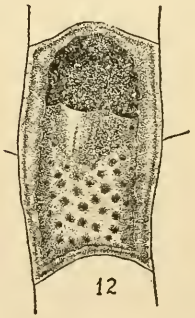

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PLATE 12

Fig. 1. *Thalamoporella gothica* (Busk), zooecium, avicularium, caliper and compass.

Fig. 2. *Thalamoporella californica* (Levinsen), zooecium, avicularium and caliper.

Fig. 3. *Steganoporella cornuta* new species. Details of ordinary zooecium.

Fig. 4. The same, "B zooecium," showing much larger aperture and absence of spines.

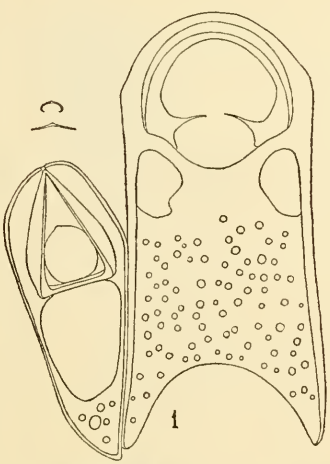
Fig. 5. The same, balsam mount of operculum with portion of attached frontal membrane.

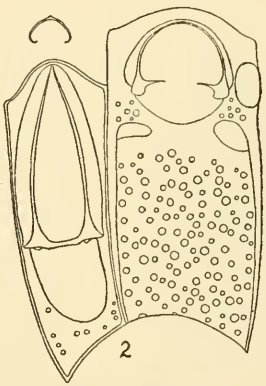
Fig. 6. The same, operculum of "B zooecium" showing the heavy supporting sclerites and toothed border.

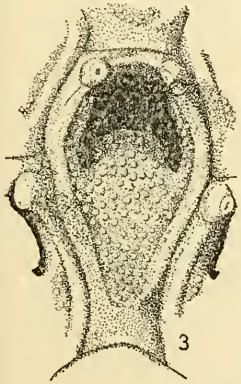
Fig. 7. *Velumella americana* Canu and Bassler, zooecium and avicularian chamber.

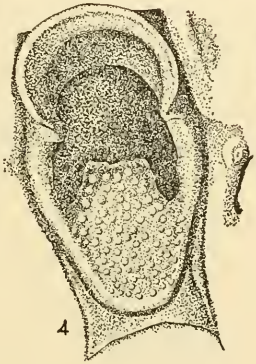
Fig. 8. The same, winged mandible of avicularium.

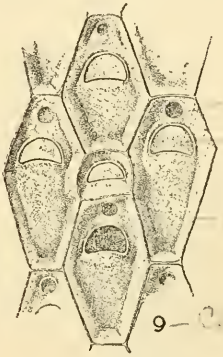
Fig. 9. *Cellaria diffusa* Robertson.


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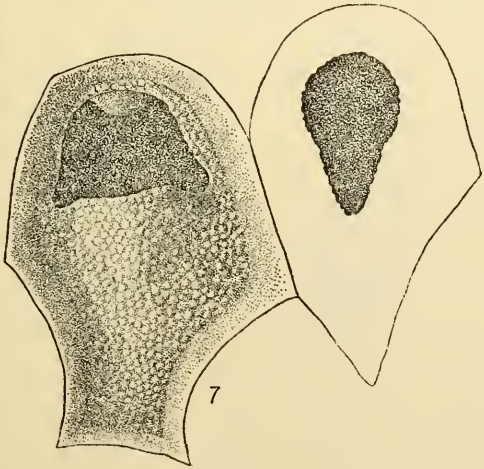

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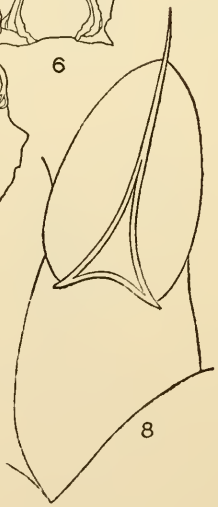

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PLATE 13

Fig. 1. *Cellaria mandibulata* Hincks.

Fig. 2. *Cellaria veleronis* new species.

Fig. 3. *Nellia tenuis* Harmer.

Fig. 4. *Nellia oculata* Busk.

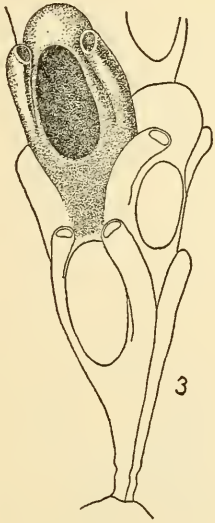
Fig. 5. *Synnotum aegyptiacum* (Audouin), with sessile and pedunculate avicularia.

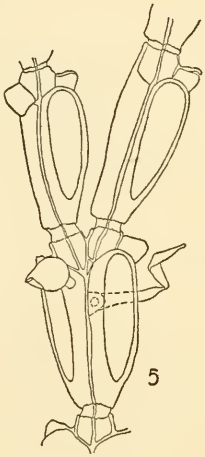
Fig. 6. *Tricellaria occidentalis* (Trask).

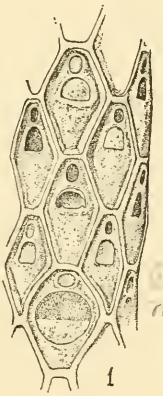
Fig. 7. The same, with ovicell.

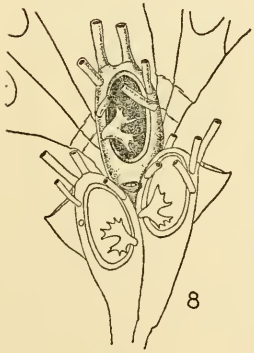
Fig. 8. *Tricellaria occidentalis* var. *catalinensis* (Robertson), showing much branched scutum.

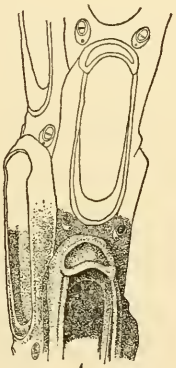
Fig. 9. The same, with ovicell.

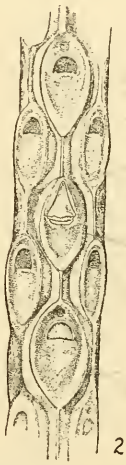

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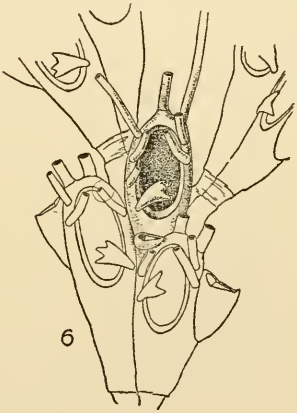

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PLATE 14

Fig. 1. *Tricellaria ternata* (Solander).

Fig. 2. The same, dorsal view.

Fig. 3. *Tricellaria gracilis* (Smitt).

Fig. 4. The same, dorsal view.

Fig. 5. *Tricellaria praescuta* new species. Note broad proximal scutes and absence of frontal avicularia.

Fig. 6. The same, dorsal view.

Fig. 7. *Tricellaria erecta* (Robertson), showing large size, scarcity of spines and smooth ovicell.

Fig. 8. The same, dorsal side, reduced.

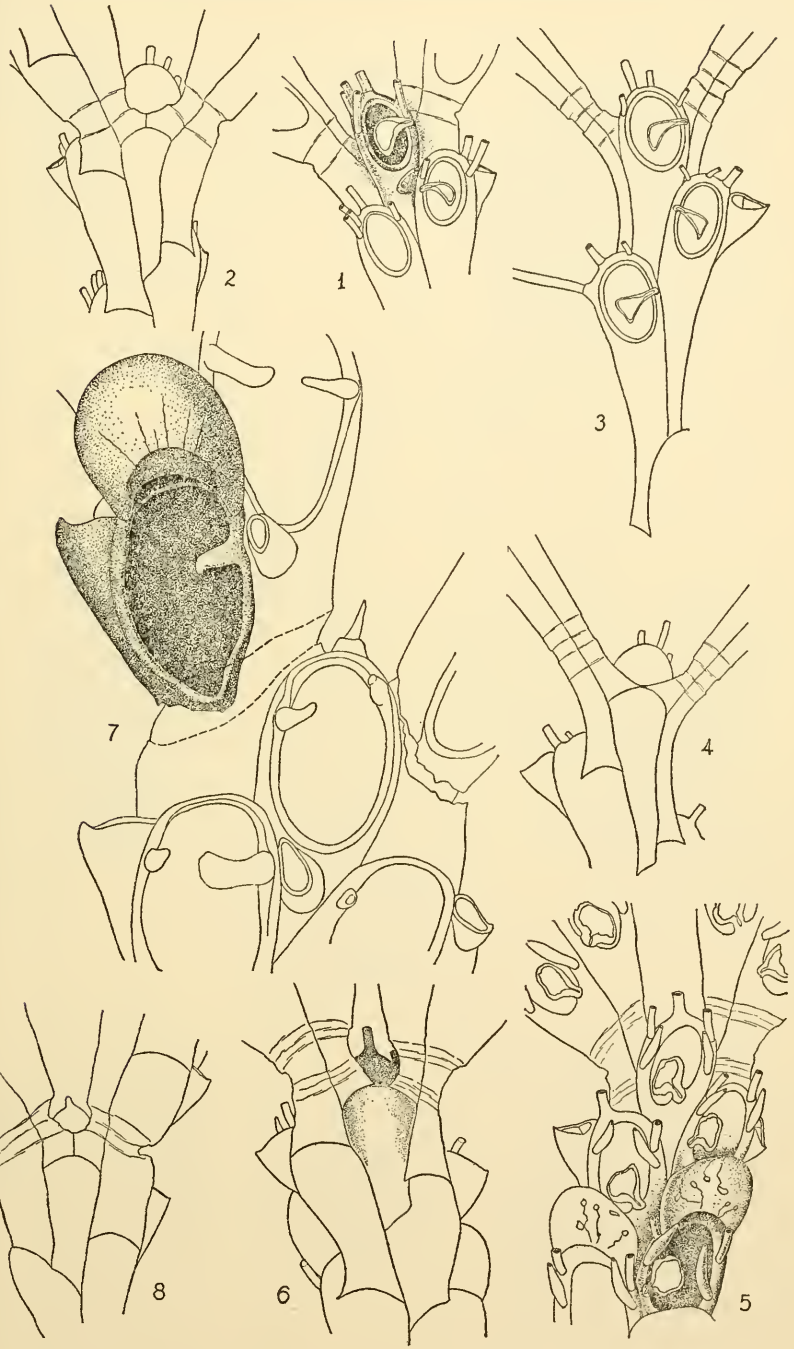

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PLATE 15

Fig. 1. *Amastigia biseriata* new species.

Fig. 2. The same, dorsal view, showing the peculiar median avicularium and short dorsal ones.

Fig. 3. The same, ovicell.

Fig. 4. *Caberea boryi* (Audouin), showing scutum, normal frontal avicularia and ovicell.

Fig. 5. The same, dorsal view of the vibracular chambers.

Fig. 6. The same, giant avicularium.

Fig. 7. *Scrupocellaria bertholetti* (Audouin).

Fig. 8. The same, showing giant avicularium.

Fig. 9. *Scrupocellaria diegensis* Robertson, ovicell, scutum and avicularium.

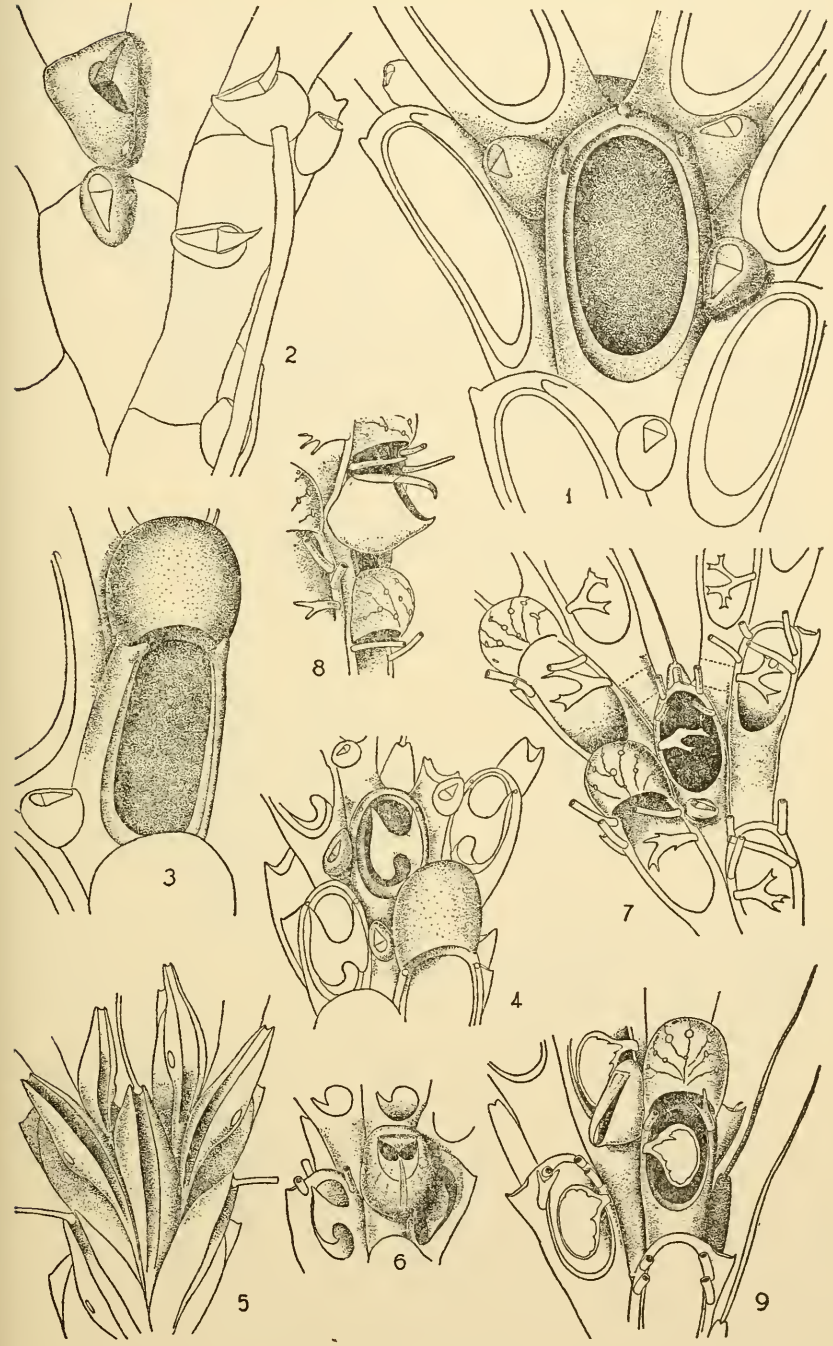

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PLATE 16

Fig. 1. *Caberea ellisi* (Fleming), note the absence of a scutum.

Fig. 2. The same, dorsal view showing the vibracular chambers.

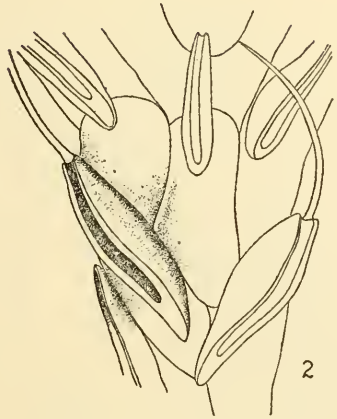
Fig. 3. *Amastigia rudis* (Busk).

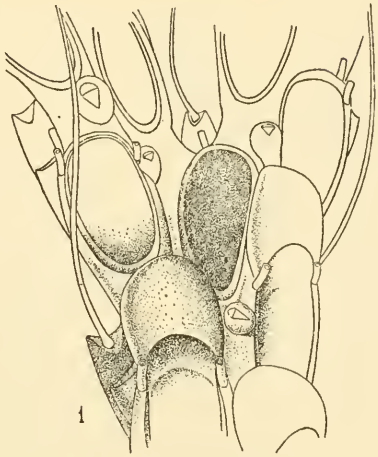
Fig. 4. The same, dorsal view, vibraculiform avicularia.

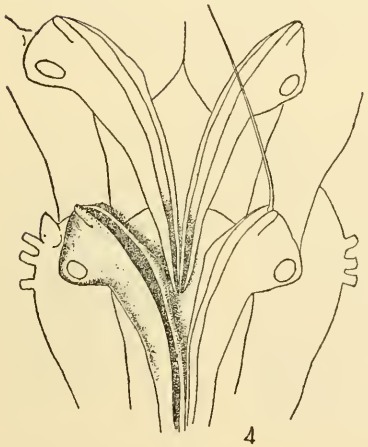
Fig. 5. The same, ovicell and different sizes of avicularia.

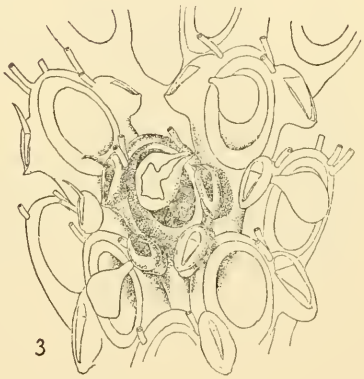
Fig. 6. *Scrupocellaria californica* Trask, dotted lines show position of joint.

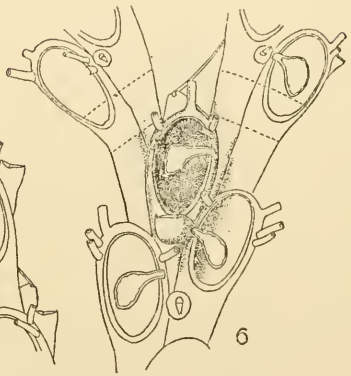
Fig. 7. The same, giant lateral avicularium.

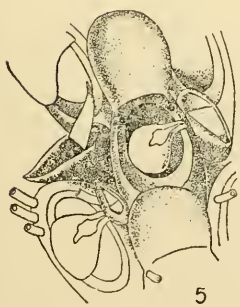

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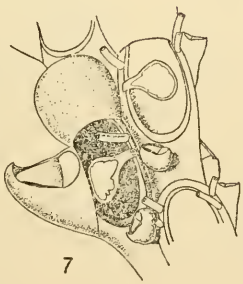

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PLATE 17

Fig. 1. *Scrupocellaria unguiculata* new species.

Fig. 2. The same, ovicell, scutum and giant lateral avicularia.

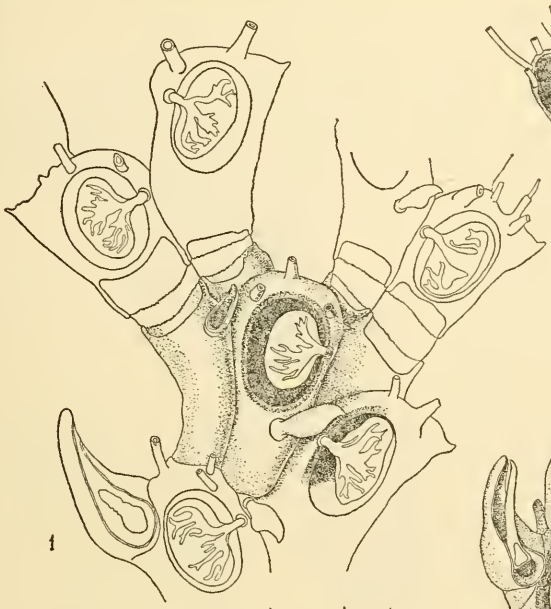
Fig. 3. *Scrupocellaria talonis* new species, small frontal and giant lateral avicularia and absence of scutum.

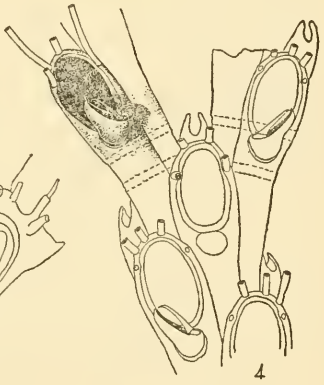
Fig. 4. *Scrupocellaria pugnax* new species, salient giant frontal avicularia, strong spines and absence of scutum.

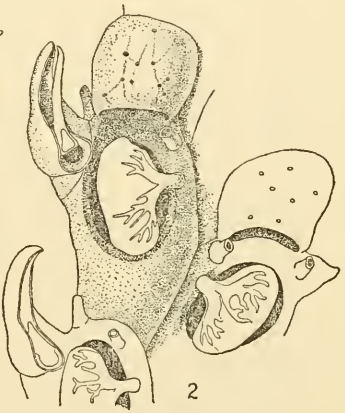
Fig. 5. *Scrupocellaria panamensis* new species.

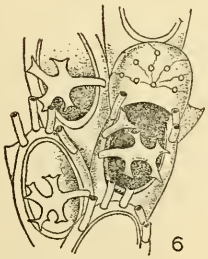
Fig. 6. The same, ovicell.

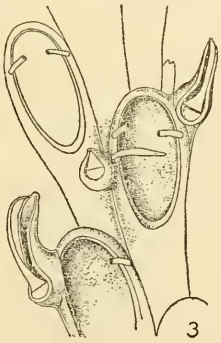
Fig. 7. *Scrupocellaria profundis* new species, twin median vibracula, small frontal avicularium, elongate opesia and absence of scutum.

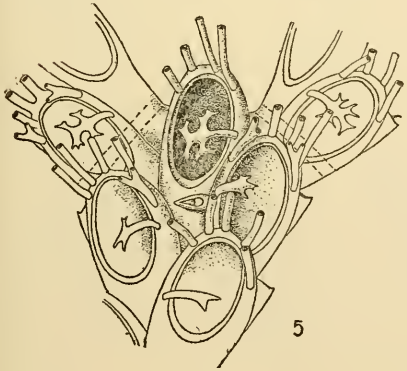

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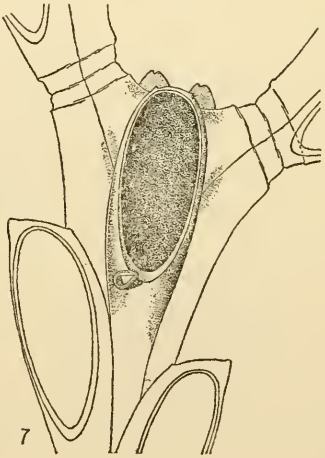

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PLATE 18

Fig. 1. *Scrupocellaria mexicana* new species.

Fig. 2. The same, ovicells.

Fig. 3. *Scrupocellaria regularis* Osburn.

Fig. 4. The same, ovicells.

Fig. 5. *Scrupocellaria scabra* (van Beneden).

Fig. 6. *Scrupocellaria scabra* var. *paenulata* Norman, greatly expanded scutum.

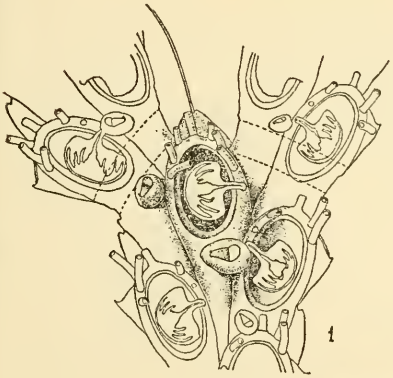
Fig. 7. *Scrupocellaria obtecta* Haswell.

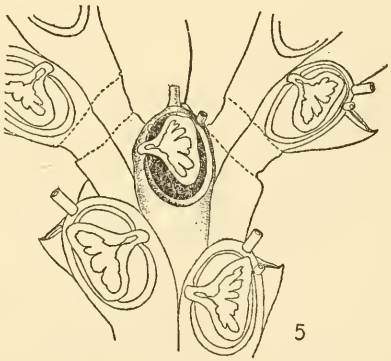
Fig. 8. *Scrupocellaria bertholetti* var. *tenuirostris* new var., showing more complete scutum and elongate median avicularium.

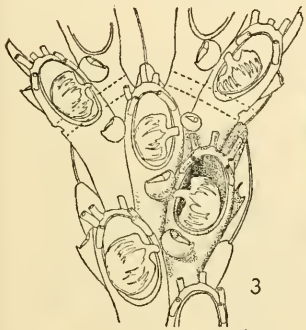
Fig. 9. *Scrupocellaria harmeri* Osburn, frontal view of zooecium with spines and lateral avicularium.

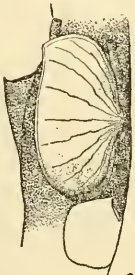
Fig. 10. The same, ovicell and scutum.

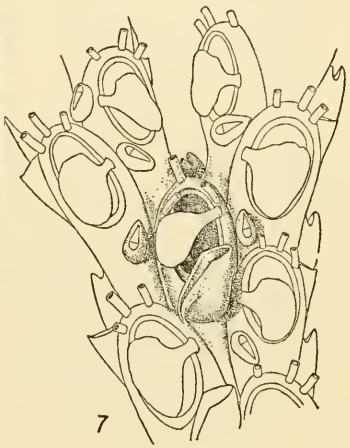
Fig. 11. *Scrupocellaria ferox* Busk, broad transverse giant avicularium and absence of scutum.

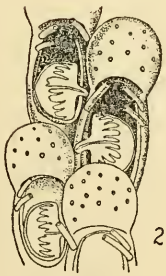

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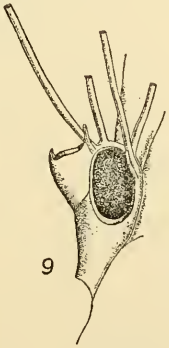

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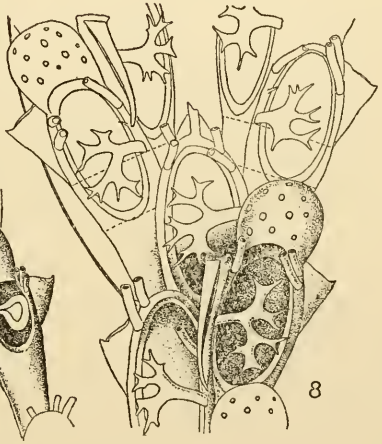

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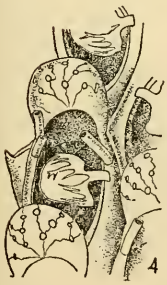

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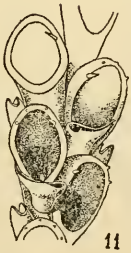

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PLATE 19

Fig. 1. *Scrupocellaria scruposa* (Linnaeus), twinned axial vibracula and absence of scutum.

Fig. 2. *Scrupocellaria macropora* new species.

Fig. 3. *Scrupocellaria talonis* new species, frontal and lateral avicularia and absence of scutum.

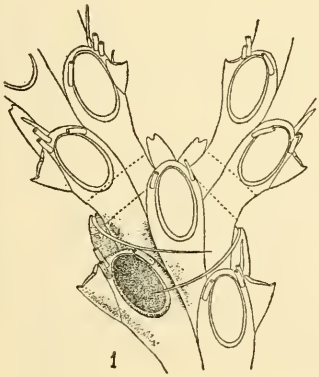
Fig. 4. *Scrupocellaria ferox* Busk, vibracular chamber and position of radicle chamber.

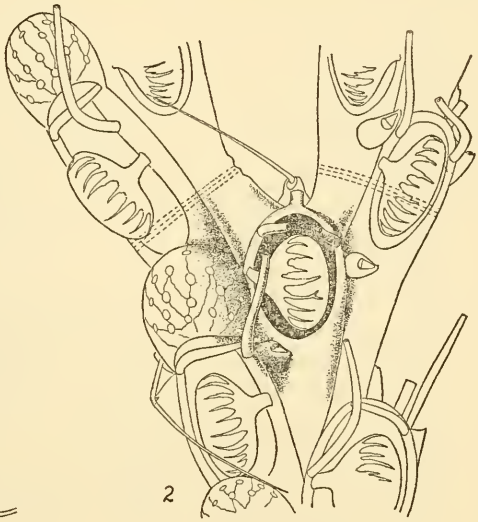
Fig. 5. *Scrupocellaria varians* Hincks, varying scuta, normal frontal and lateral and giant lateral avicularia.

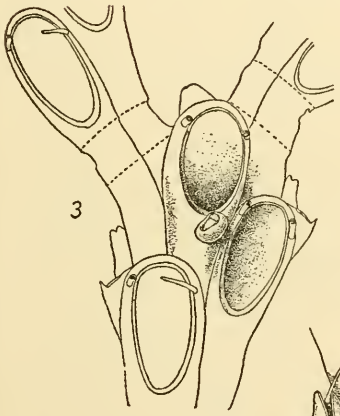
Fig. 6. *Scrupocellaria unguiculata* new species, vibracular and radicle chambers and normal lateral avicularia.

Fig. 7. *Scrupocellaria spinigera* new species.

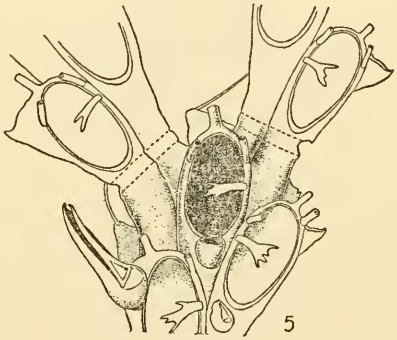
Fig. 8. The same, with ovicell.

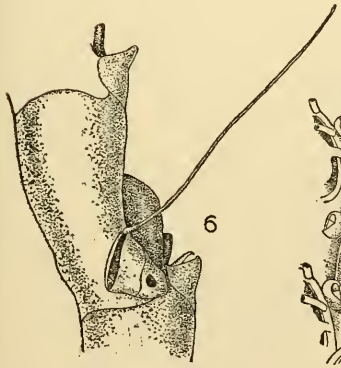

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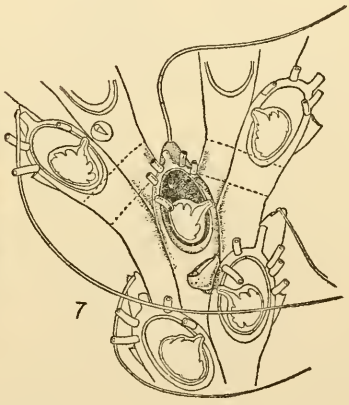

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PLATE 20

Fig. 1. *Scrupocellaria macropora* new species, lateral and axial vibracula.

Fig. 2. *Scrupocellaria panamensis* new species, lateral and axial vibracula.

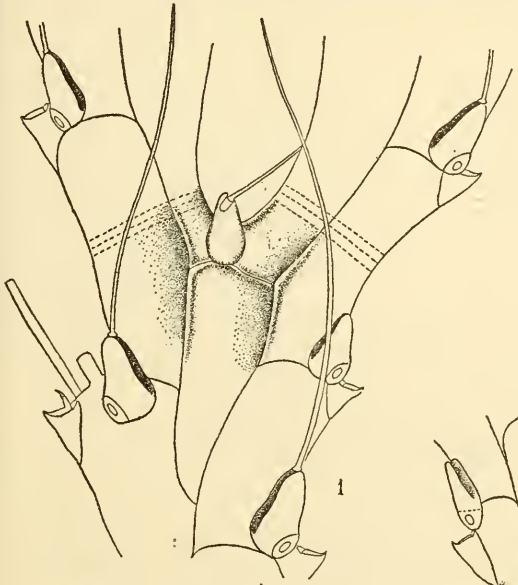
Fig. 3. *Scrupocellaria regularis* Osburn, lateral and axial vibracula.

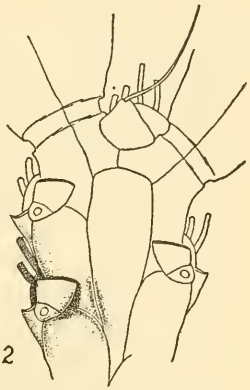
Fig. 4. *Scrupocellaria harmeri* Osburn, lateral and twinned axial vibracula.

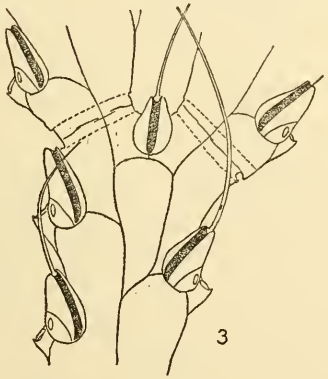
Fig. 5. *Scrupocellaria californica* Trask, lateral and axial vibracula.

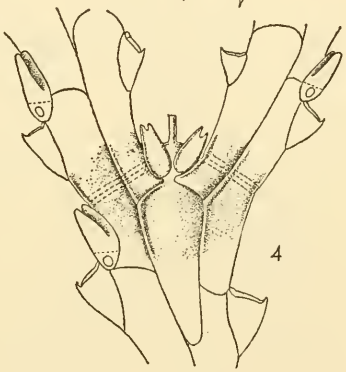
Fig. 6. *Scrupocellaria varians* Hincks, lateral and axial vibracula, and giant lateral avicularium.

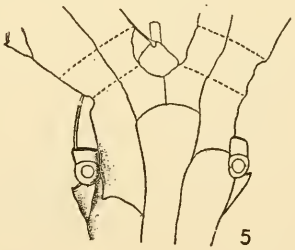
Fig. 7. *Scrupocellaria talonis* new species, lateral and axial vibracula.

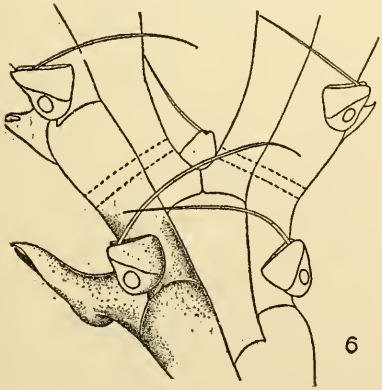

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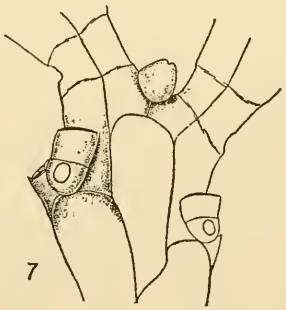

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PLATE 21

Fig. 1. *Scrupocellaria profundis* new species, lateral and twinned axial vibracula.

Fig. 2. *Scrupocellaria scruposa* (Linnaeus), lateral and twinned axial vibracula.

Fig. 3. *Scrupocellaria mexicana* new species, lateral and axial vibracula.

Fig. 4. *Scrupocellaria obtecta* Haswell, lateral and axial vibracula.

Fig. 5. *Scrupocellaria pugnax* new species, lateral and axial vibracula.

Fig. 6. *Scrupocellaria bertholetti* var. *tenuirostris* new variety, lateral and axial vibracula.

Fig. 7. *Scrupocellaria spinigera* new species.

Fig. 8. *Scrupocellaria bertholetti* (Audouin), lateral and axial vibracula.

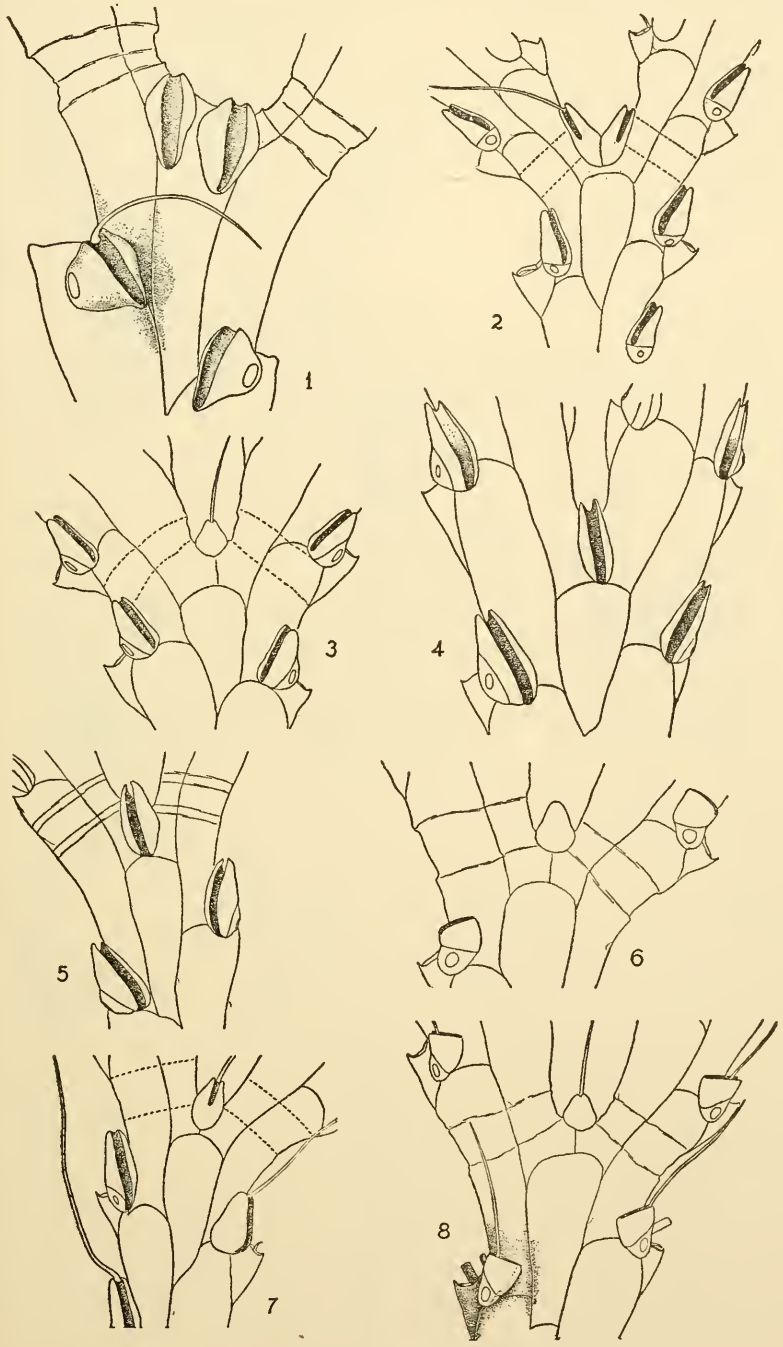

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PLATE 22

Fig. 1. *Scrupocellaria diegensis* Robertson, lateral and axial vibracula.

Fig. 2. *Scrupocellaria scabra* (van Beneden), lateral and axial vibracula.

Fig. 3. *Bugula mollis* Harmer, incomplete ovicell and joint at base of branch.

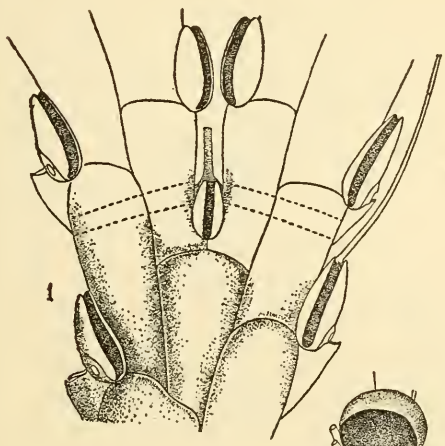
Fig. 4. *Bugula cucullifera* Osburn, hooded ovicell.

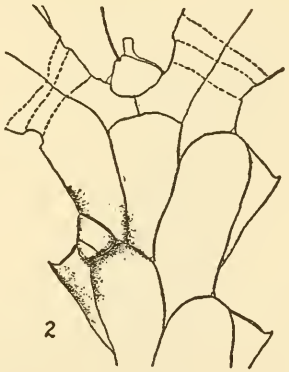
Fig. 5. The same, spines at tip of branch.

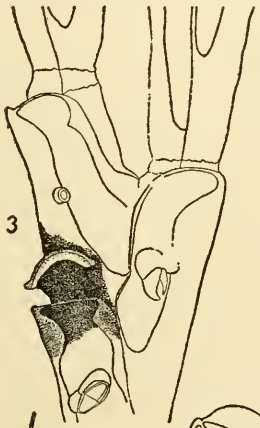
Fig. 6. *Bugula pacifica* Robertson, diminutive, cap-like ovicell.

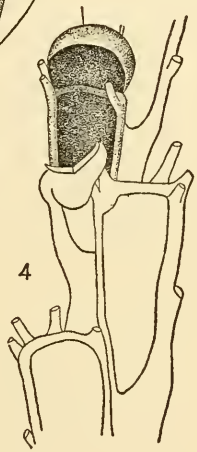
Fig. 7. *Bugula longirostrata* Robertson, vestigial ovicell and elongate avicularia.

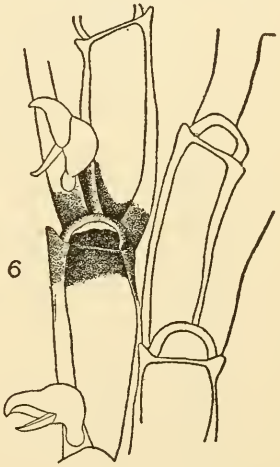
Fig. 8. *Bugula minima* (Waters), absence of spines, small proximal avicularia.

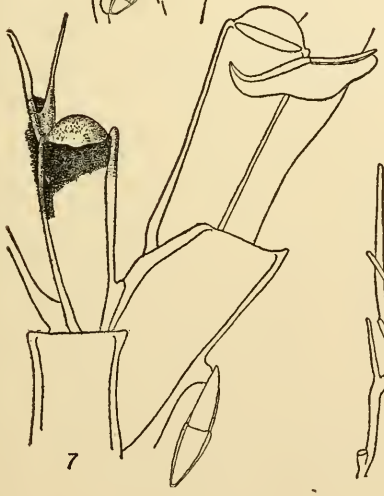

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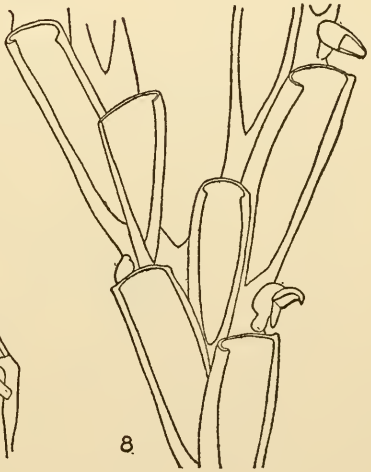

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PLATE 23

Fig. 1. *Bugula californica* Robertson.

Fig. 2. *Hincksina pallida* (Hincks). Note large interzooecial avicularium and outline of submerged ovicell.

Fig. 3. *Bugula neritina* (Linnaeus), ovicell.

Fig. 4. *Bugula pacifica* Robertson, dorsal view.

Fig. 5. *Bugula minima* (Waters), dorsal view.

Fig. 6. *Bugula mollis* Harmer, dorsal view.

Fig. 7. *Bugula pugeti* Robertson, vestigial ovicell and variation in size of avicularia.

Fig. 8. The same, dorsal view.

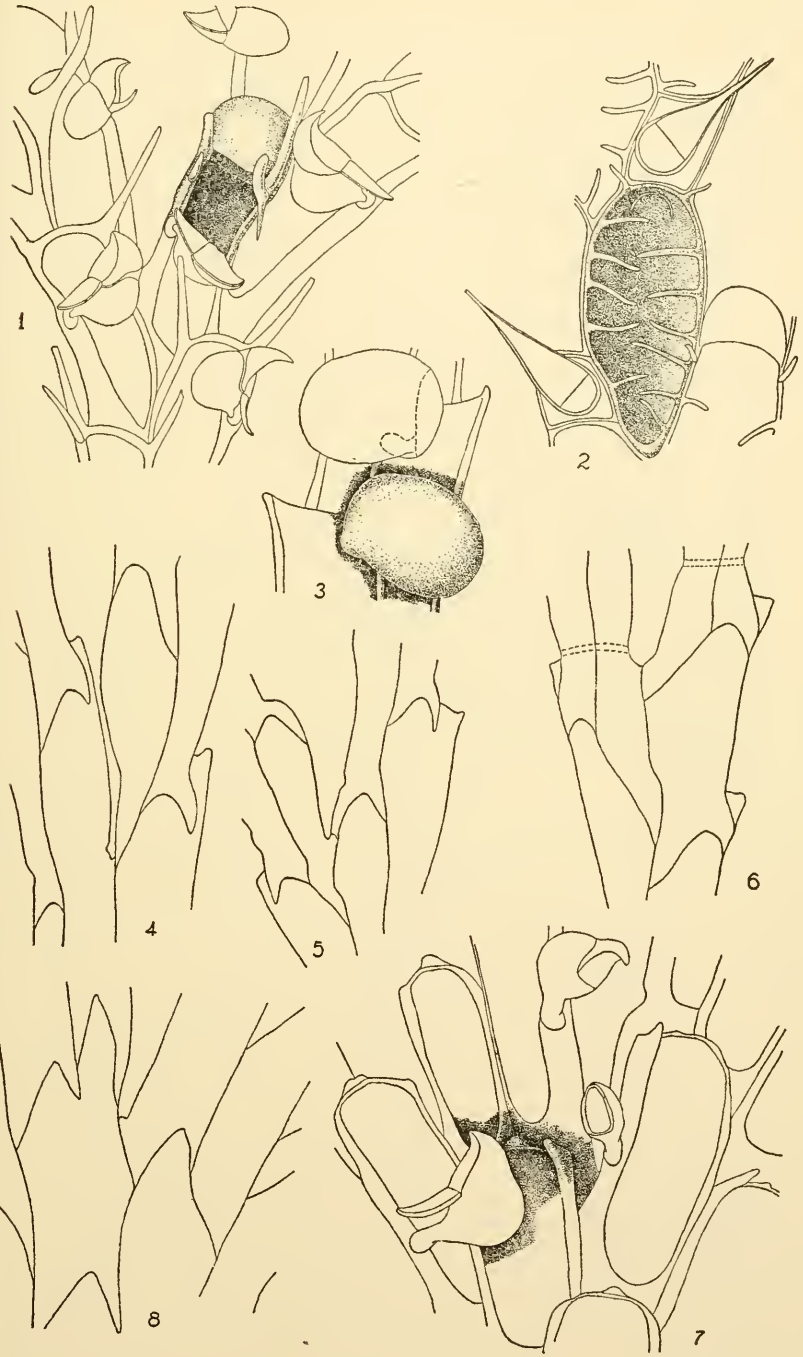

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PLATE 24

Fig. 1. *Bugula longirostrata* Robertson, dorsal view.

Fig. 2. *Bugula californica* Robertson, dorsal view.

Fig. 3. *Bugula neritina* (Linnaeus), dorsal view.

Fig. 4. *Caulibugula ciliata* (Robertson).

Fig. 5. The same, with ovicell.

Fig. 6. *Caulibugula occidentalis* (Robertson), with ovicell.

Fig. 7. *Caulibugula californica* (Robertson).

Fig. 8. The same, stalk internodes (kenozooecia).

Fig. 9. *Corynoporella spinosa* Robertson, zooecium showing mode of branching and short spines.

Fig. 10. The same, stalked lateral avicularium.

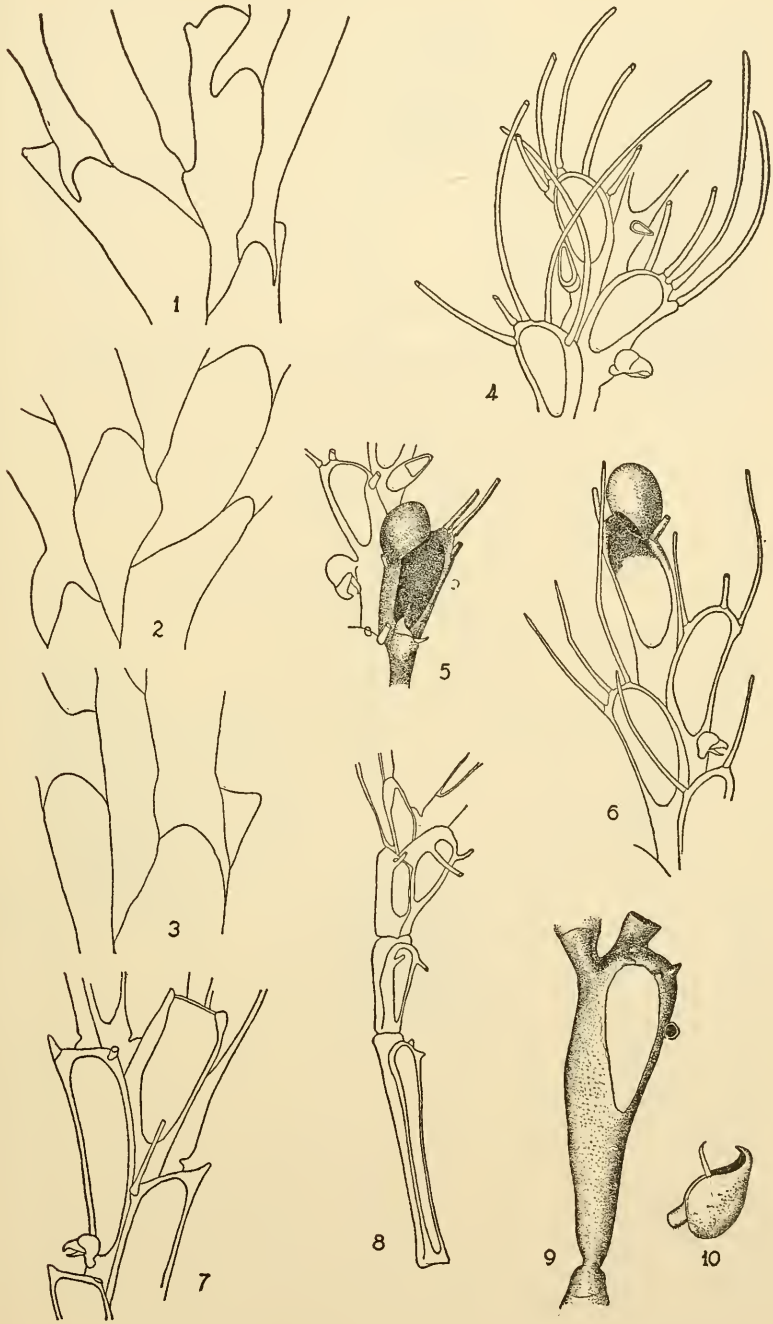

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PLATE 25

Fig. 1. *Dendrobeania murrayana* var. *fruticosa* (Packard), two sizes of avicularia, median and lateral.

Fig. 2. *Dendrobeania laxa* (Robertson), with ovicell.

Fig. 3. The same, infertile zooecium.

Fig. 4. *Dendrobeania longispinosa* (Robertson).

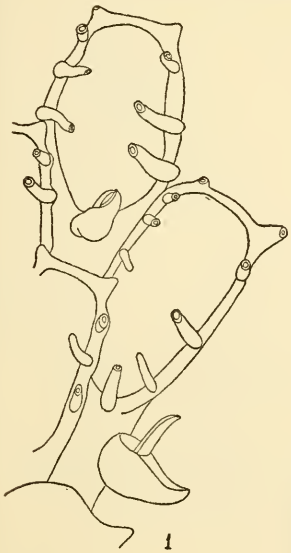
Fig. 5. The same, ovicell.

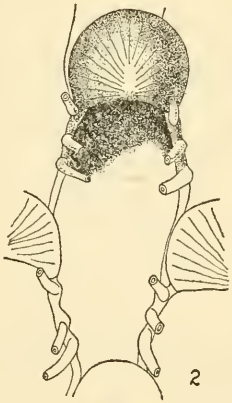
Fig. 6. *Dendrobeania lichenoides* (Robertson), with ovicell.

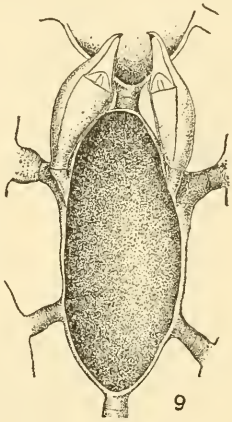
Fig. 7. *Dendrobeania curvirostrata* (Robertson), with ovicell and elongate avicularium.

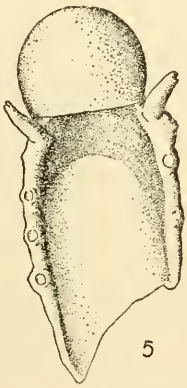
Fig. 8. The same, at growing tip.

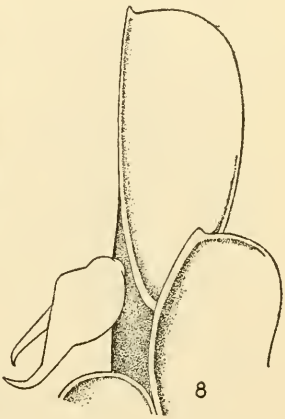
Fig. 9. *Beania magellanica* (Busk), showing paired avicularia and connecting tubules.

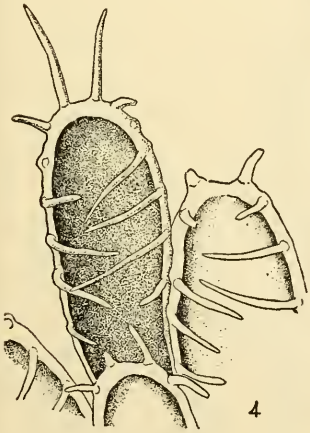

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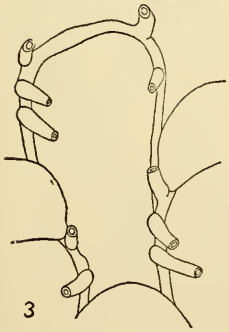

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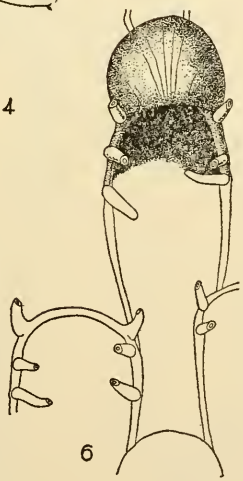

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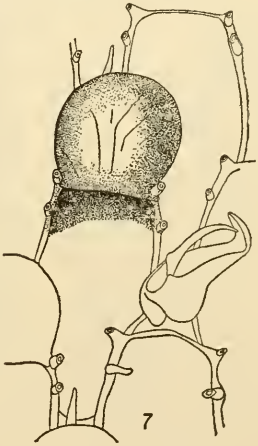

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PLATE 26

Fig. 1. *Sessibugula translucens* new species, outline of zooecium near edge of zoarium, with ovicell and paired, stalked avicularia on the gymnocyst.

Fig. 2. The same, old and fully developed zooecium in a more crowded part of the zoarium, with strong, jointed spines which are sometimes branched; small avicularia. Below an avicularium with the mandible everted.

Fig. 3. The same, dorsal view showing overlapping of zooecia and the arrangement of communication pores.

Fig. 4. *Beania hirtissima* (Heller), frontal view.

Fig. 5. The same dorsal view showing dorsal spines and the transformation of one into a holdfast.

Fig. 6. *Beania alaskensis* new species, side view showing the elongate terminal spines and thick basal tubular portion.

Fig. 7. The same, frontal view showing the strong terminal spines and the twinned lateral ones.

Fig. 8. *Beania mirabilis* Johnston, side view showing narrow proximal tubule, small terminal and single lateral spines.

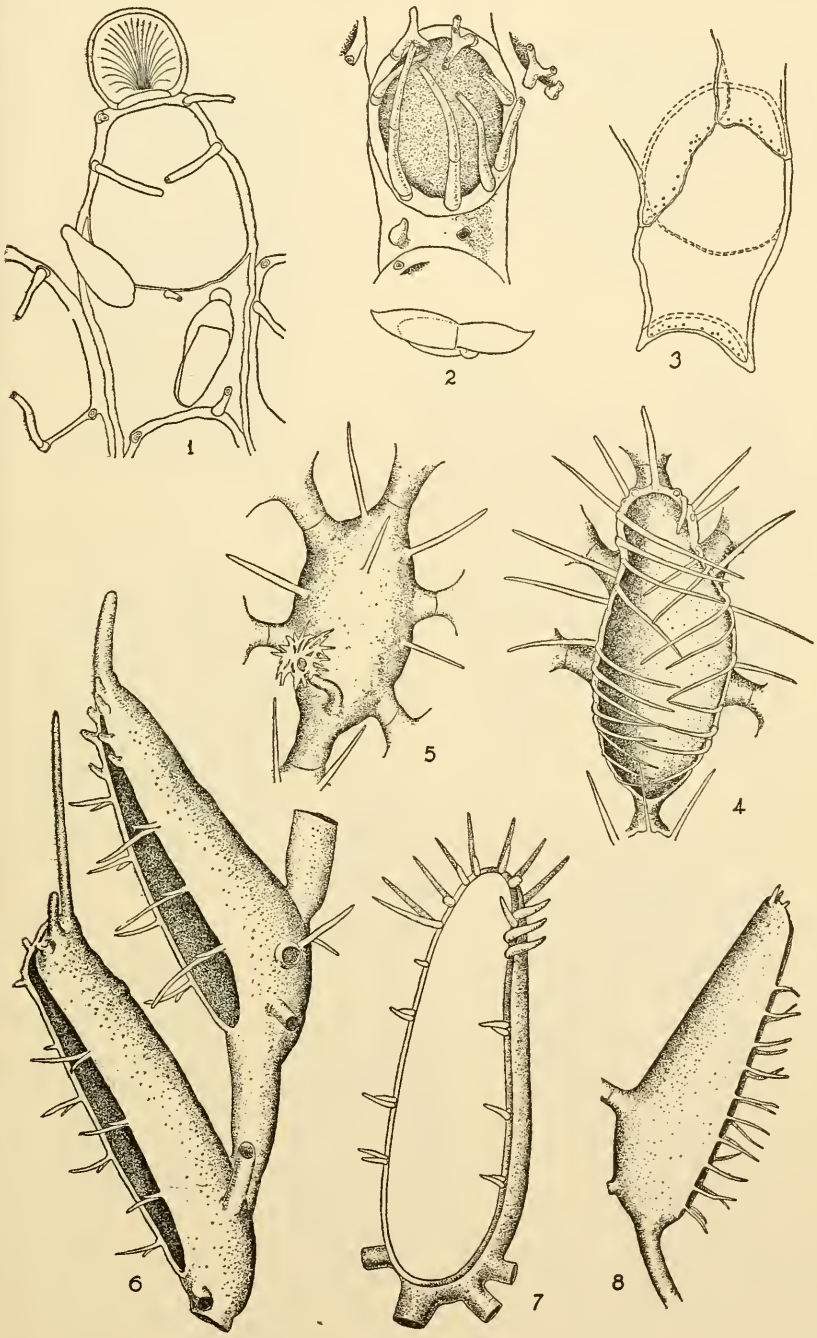

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PLATE 27

Fig. 1. *Membraniporella crassicosta* Hincks, usual appearance with heavy spines little developed upward.

Fig. 2. The same, a zooecium near the center of the zoarium, with the spines united above the opesia.

Fig. 3. *Membraniporella aragoi* var. *pacifica* new variety.

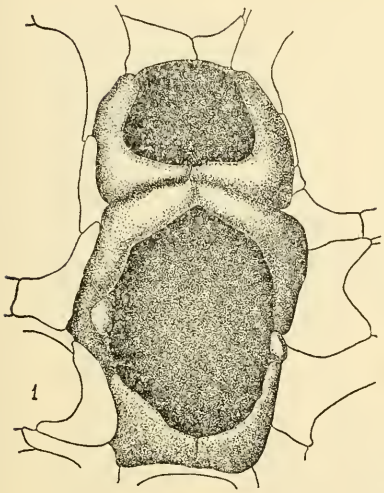
Fig. 4. The same, showing ovicell and the fully developed lateral oral spines.

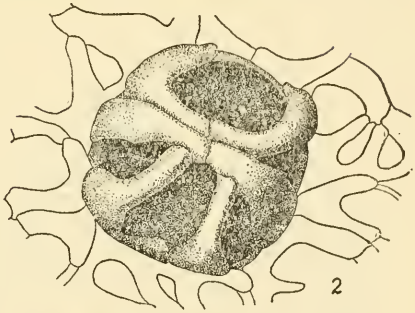
Fig. 5. *Membraniporella pulchra* new species.

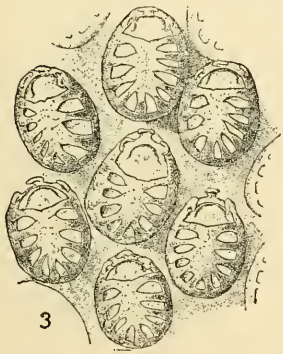
Fig. 6. The same, with ovicell.

Fig. 7. *Lyrula hippocrepis* (Hincks), normal appearance with large vicarious avicularium.

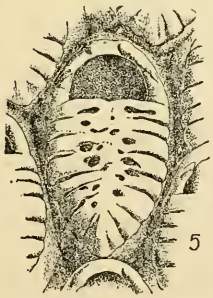
Fig. 8. The same, old stage of calcification.

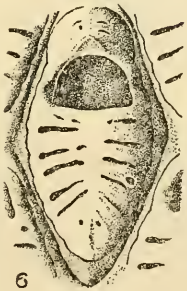

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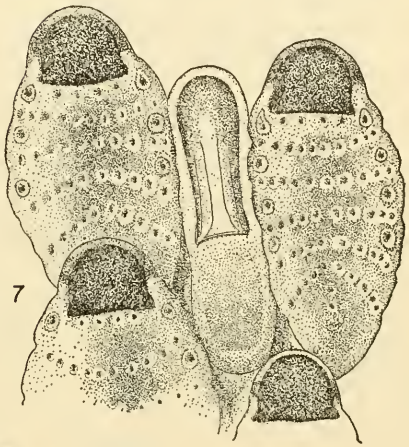

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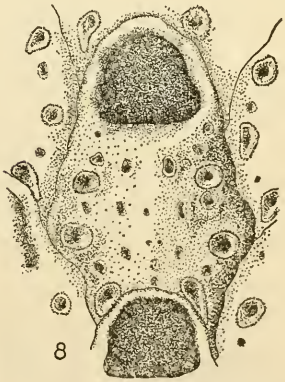

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PLATE 28

Fig. 1. *Reginella nitida* new species.

Fig. 2. *Reginella mattoidea* new species.

Fig. 3. *Reginella furcata* (Hincks), with short bifid spines.

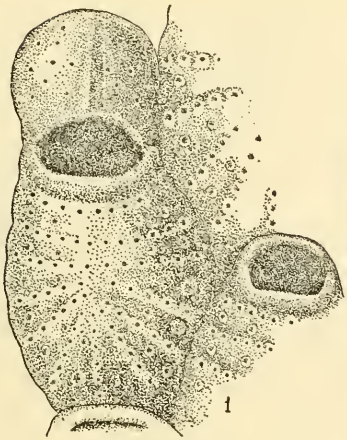
Fig. 4. *Reginella mucronata* (Canu and Bassler), with mucronated oral bar, drawn to a somewhat smaller scale.

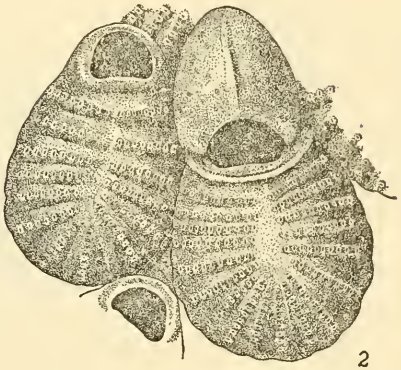
Fig. 5. *Reginella spitsbergensis* (Norman), with ovicell and two pairs of short lateral oral spines.

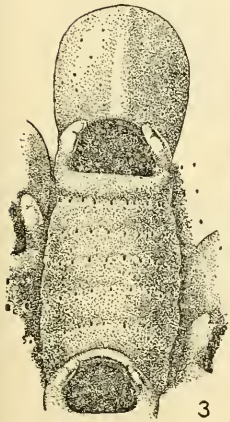
Fig. 6. The same, young zooecia at growing edge.

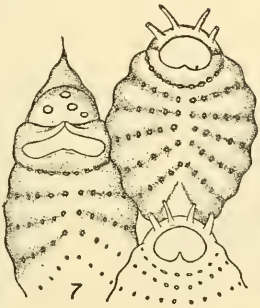
Fig. 7. *Cribrilina annulata* (Fabricius), zooecia and ovicell.

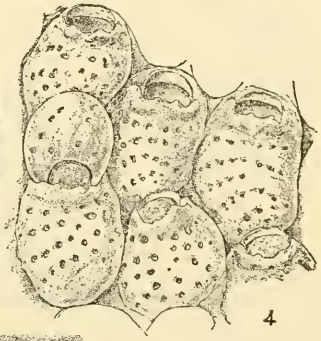
Fig. 8. *Figularia hilli* new species, drawn to a somewhat smaller scale.

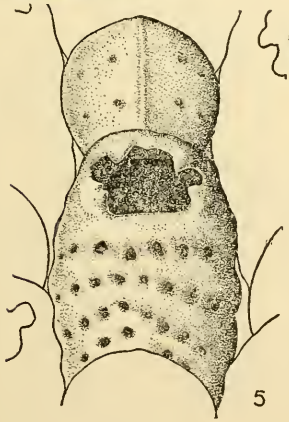

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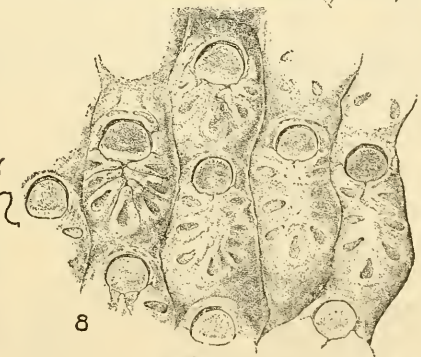

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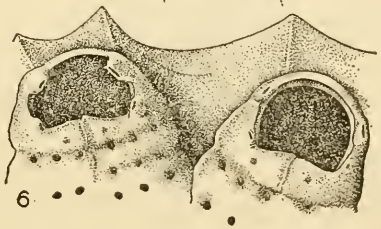

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PLATE 29

Fig. 1. *Colletosia bellula,* new species. Note form of aperture and lateral-oral pedunculate avicularia.

Fig. 2. *Colletosia radiata* (Moll), the form *innominata* (Couch).

Fig. 2a. The same, interzooecial avicularium.

Fig. 3. *Reginella mucronata* (Canu and Bassler), young zooecia at margin of zoarium.

Fig. 4. *Puellina setosa* (Waters). Note especially the minute bristle-like avicularia opposite the aperture.

Fig. 5. *Euritina arctica* new species. Details of skeleton, with base of ovicell.

Fig. 5a. The same, showing hyperstomial ovicell, larger aperture and the attachment of the operculum.

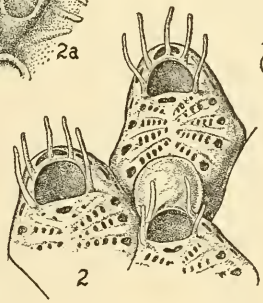
Fig. 6. *Mollia patellaria* (Moll), details of young zooecia.

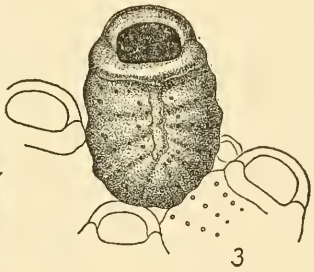
Fig. 7. *Antropora tincta* (Hastings). Area with vestigial avicularia.

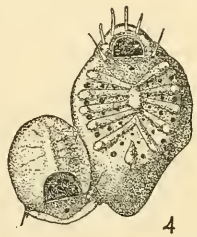
Fig. 8. The same, showing details of zooecium and avicularium and variations in size and form of avicularia and vestigial avicularian chambers.

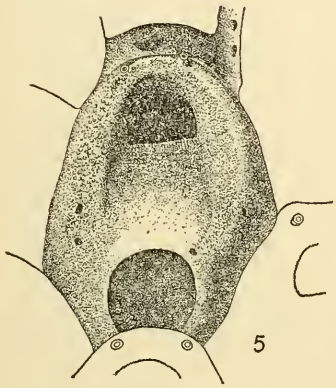

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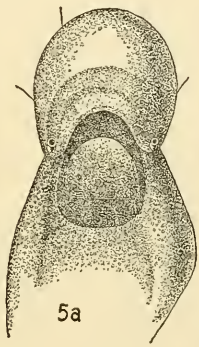

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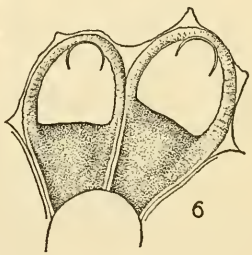

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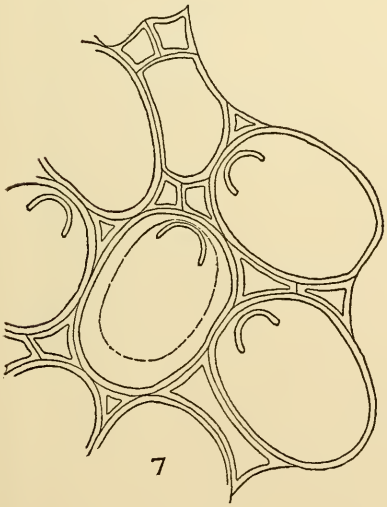

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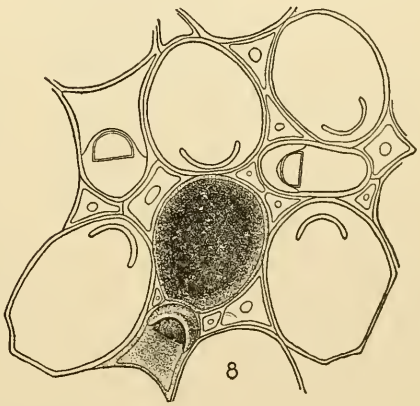

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